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MID-CHANNEL TELEGRAPH STATIONS.

The establishment of telegraphic communication with Lundy Island in the Bristol Channel which has just been effected must prove of immense benefit to the large shipping trade which is carried on by the South Wales seaports; indeed, as in the case of many other enterprises, the wonder is that the communication has not been effected before. Telegraphic signal stations have now existed for some years on the southern coast of this country and have proved, we believe, very successful and of great benefit to the shipping community. About 12 years ago, a company was formed for the purpose of establishing telegraphic communication with a floating signal station anchored in the English Channel. This station, which was situated about 70 miles from the shore, at a shoal known as the "Admiralty Patch," was for some little time in successful operation, but owing to the continual breakages of the cable which took place, the enterprise had eventually to be given up. The failure was, we believe, due to causes which are not hopelessly incurable and which are quite capable of being got over. The floating vessel was quite unsuited for the purpose and too faithfully answered to its name the *Brisk*, the result being that the cable continually fouled the mooring chains and broke. Had a vessel been specially designed for the purpose and the cable been interwoven with a chain of special construction, as suggested and patented by Mr. F. R. Lucas, it is quite probable that a commercial success, instead of a failure, would have been attained. The advantages of such floating stations are so obvious that they do not require to be brought prominently forward; indeed, at the time the formation of the "Mid-Channel" Company was suggested, the idea was quickly taken up and the capital was soon subscribed. Since the failure of the scheme no further attempt of any kind seems to have been made to establish Mid-Channel stations. Of course, the number of cases in which such stations would be of benefit would not be large, but the stations would prove, we believe, very remunerative, as a comparatively high tariff could be charged without risk of the shipowners failing to avail themselves of the great advantages offered them, for to the latter it would mean many pounds saved at the expense of a few shillings. It has more than once been suggested that telegraphic communication should be effected with some of our isolated lighthouses, the "Eddystone" and the "Wolf," for example; although the advantages of this would be extremely great both from a humanitarian as well as a utilitarian point of view, it is somewhat doubtful whether such schemes would be practicable. In the case of the Lundy Island cable, the difficulties of obtaining suitable landing places were excessively great owing to the iron-bound and precipitous nature of the coasts, but these difficulties were overcome; and as the cable is of an exceptionally excellent mechanical (as well as electrical) construction and judiciously placed, there is no reason to suppose but that its continuity will remain unimpaired for a lengthened period. In the case of the lighthouses we have mentioned the landing places are as bad as they could possibly be, and no matter how carefully the cables were secured (a matter of great difficulty), it is very doubtful whether they would last out many severe gales.

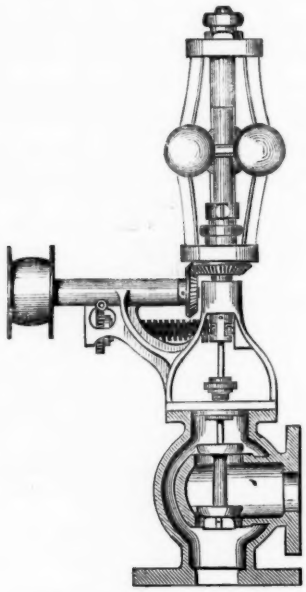
THE EVANS-PICKERING GOVERNOR.

The object of this invention, introduced by Messrs. Ransome & Marshall, Scotland Road, Liverpool, is to obtain the requisite centrifugal force and stiffness without the use of a spiral spring, and consists in the adaptation of a flat spring or number of flat springs placed together in such a manner as to secure the ends and middle portion, and at the same time to keep these parts at all times parallel with the centre of motion. The bands of steel used for this purpose are about No. 20 W.G. in the 4 inch size, and consequently, being so thin and elastic, they are not at all liable to break, neither are they liable to "set" or lose their elasticity. A peculiar curve is obtained by this arrangement, called

a double cyma, by the use of which two or more strips firmly secured together will work freely without tendency to buckle or interfere with each other's action.

As may be seen by the engraving, the ends of the springs are secured to flanges, the lower of which resting on steel washers, and having a collar to prevent its rising, is capable of only a rotary motion, while the upper one, being at liberty to move lengthways as well as to rotate, receives its rotary motion from the lower one through the springs, and communicates any lateral motion due to the varying centrifugal force immediately to the balanced valve, to which the governor is firmly secured by the bracket. The valves are of the equilibrium type. There being no joints or pins, the governor is both durable and trustworthy, and is very much in favour for use on electric light engines. On all the recent governors there is a spiral spring brake,

which enables the engine to be run at varying speeds, and is very useful when attaching to old engines, as the governor can often be adjusted by means of this without altering the size of existing governor pulley on engine. The speed at which it should be run is



stamped upon each governor. The governor is in considerable use, being employed by Messrs. Garrett and Sons, of Leiston, Siemens Brothers, J. & H. Gwynne, Thomas Piggott & Co., Tangye Brothers, the Trans-Atlantic Steamship Company, and others.

We are indebted to the *Engineer* for the above description, and to Messrs. Marshall & Ransome for the blocks wherewith to illustrate the apparatus.

THE LATE ELECTRICAL EXHIBITION AT THE CRYSTAL PALACE.

(*Continued from page* 324.)

The experiments at the Crystal Palace on gas engines and on dynamo machines were carried out by the same committee, consisting of Mr. Horace Darwin, Mr. F. J. Sprague, Mr. Spagnoletti, Mr. Crampton, and Prof. W. G. Adams—Mr. F. J. Sprague devoting himself most zealously to the work.

The engine supplying the power to drive the dynamo machines was kindly lent by Messrs. Davey, Paxman & Co. It was a semi-fixed single-cylinder engine, which ran very regularly, and was capable of giving from 40 to 43 H.P. in the cylinder, and did not use in the various experiments more than from 1½ to 3 H.P. for friction. The transmission dynamometer and the electrical apparatus for testing were kindly lent by Messrs. Latimer Clark, Muirhead & Co.

*The Dynamometer** (fig. 1).—The two parts of the belt from the fly-wheel of the engine passed between two 9 inch pulleys, A, A, which are mounted in a frame attached to a fixed standard to the pulley, Q, on the shaft. The frame supporting the pulleys was supported at one end of a long lever, U, T, and counterpoised. The lower belt was the driving belt, and the pull upon the end of the lever was equal to the difference of the tensions of the lower and upper belts resolved at right angles to the line joining the centres of the fly-wheel and the shaft, Q. The centre of the fly-wheel was nearly on a level with the floor, so that the line joining the centres of the fly-wheel and shaft was inclined 2° to the horizontal. The lineal speed of the belt varied from 44 to 51 feet per second, and the difference of tension on the two parts of the belt was as much as 250 to 300 lbs. for the heavier loads. Near the pulleys, A, A, and between them and the shaft, a wooden frame was erected, G, consisting of two uprights on opposite sides of the belt, with a cross-piece. This was the support for a lever, V, made of iron of an inverted T section, I. Through this were secured square bars of iron, u and u_1, for knife-edges. To the one at the end of the lever u_1 was hung a shackle connected with a link, K, and side-adjusting screws, the pulley frame, U. The distance between these knife-edges was 2 feet 6 inches. The other end of the lever was prolonged about 10 feet, and the end allowed 3 to 4 inches play each side of the horizontal by wooden bars. When horizontal the pulley frame was very nearly in its true middle position, and a deviation of 1 inch either way sufficient to throw the end of the lever to the extreme limit allowed. With a load on, the lever being horizontal, a slight pressure of the finger would destroy the equilibrium. The weight of the frame and pulleys, and the drag of the lower belt when at rest, was counterbalanced by the weight, J.

To determine the constant for this dynamometer, and to consider its accuracy,

Let R = radius of fly-wheel = C E = $42\frac{1}{2}''$;
r = radius of shaft pulley = Q b = $14\frac{1}{2}''$;
C = distance between faces of dynamometer pulleys mm.′ = $1\frac{1}{4}''$;
k = thickness of belt;
D = distance of centre of fly-wheel to middle of dynamometer = C E = 20′ 9″;
d = distance from centre of shaft pulley to dynamometer = Q E = 7′ 6″;
t and t_1 = tension of lower and upper belts;
p and p_1 = corresponding pulls at right angles to line of centres;
P = resultant *vertical* pull;
l and l_1 = short and long arms of lever;
2α = right enclosed angle;
2β = left enclosed angle;
s = speed per minute of rim of shaft pulley;
n = number of revolutions of shaft pulley per minute;
W = balancing weight at distance of 1 foot;
$\theta = 2° 36'$ = the angle of inclination of line of centres to the horizon.

We have

$$\alpha = \text{sin.}^{-1}\frac{R - \frac{1}{2}(c-2k)}{D} = \text{sin.}^{-1}\frac{R - \frac{1}{2}c + k}{D} = 9°45'.$$

$$\beta = \text{sin.}^{-1}\frac{r - \frac{1}{2}c + k}{d} = 9° 4'.$$

$$p = t\,(\text{sin.}\,\alpha + \text{sin.}\,\beta) \quad \cdot \quad p_1 = t_1\,(\text{sin.}\,\alpha + \text{sin.}\,\beta).$$

$$P = \frac{1}{l}W = (p - p_1)\cos.\theta = (t - t_1)\cos.\theta\,(\text{sin.}\,\alpha + \text{sin.}\,\beta).$$

Whence $$(t - t_1) = \frac{1}{l} \cdot W\frac{\sec.\theta}{\text{sin.}\,\alpha + \text{sin.}\,\beta}.$$

The work transmitted to the shaft pulley per minute is—

$$(t - t_1)s = (t - t_1) \cdot \frac{2\pi r n}{12}.$$

Now sec. $\theta = 1$ nearly, and

$$\text{sin.}\,\alpha + \text{sin.}\,\beta = \text{sin.}\ 9° 45' + \text{sin.}\ 9° 4' = \cdot 32693.$$

Hence the work transmitted per minute is

$$\frac{1}{l} \cdot W n \cdot \frac{2\pi r}{12 \times \cdot 32693} = W n \times 9{\cdot}289.$$

And the transmitted H.P. is $W n \times \cdot 000281$.

In practice the driving part of the belt becomes tight, and the upper belt becomes slack, and the part of it between the dynamometer and the fly-wheel, on which there is very little tension, will drop very considerably. In some of the experiments, when there was a heavy load, the upper belt on leaving the dynamometer dropped quite to, and sometimes below, the horizontal. This would only occur with large loads, when there was very little tension on this part of the

* The description and illustration of this apparatus appear not to agree, although precisely the same as published in the "Journal of the Society of Telegraph Engineers and Electricians."—EDS. ELEC. REV.

belt, and therefore the error from this cause would be small.

The speed was measured on the shaft pulley, Q, and the moment of the balancing forces on the long arm of the lever equals W — the force which at a distance of one foot will balance the pull on the shorter arm of the lever.

Electrical Testing.—Two beams, A A (fig. 2), about 10 feet long, were fixed, about 10 feet apart, on four posts. Across these were wound 26 coils of No. 16 galvanised iron wire. Each coil was about 60 feet long, had three full turns, and had a resistance (when cold) of about 1·5 ohms. The circuit containing the tangent-galvanometer had a resistance of 1·559 ohms. All the like ends were taken to one point, F, in the middle of a third beam, E, F, D, where connection was made with a short piece of rubber-covered, tarred, and taped wire which led to the resistance coils, R.

The other ends in two sets were taken to two mercury cups, E and D, connected by a short piece of cable, *p*. In the cup E was inserted one of the mains from the dynamo. In this way the current could be sent over from one to 26-parallel and nearly equal circuits. One of Helmholtz's double-coil tangent galvanometers, N, kindly lent by Elliot Bros., was placed in one of the circuits, a little removed from the rest. About 3·5 ampères gave a deflection of 45°, and in each experiment the number of circuits was arranged so as to give usually a deflection of from 35° to 55° on the galvanometer. In one or two cases higher deflections were unavoidable. With these currents, the wire, being freely exposed, only at times warmed to the touch. Immediately after an experiment the resistance of these wires was taken, and in no case was there an increase in resistance of more than 1 per cent.

There were three methods of measuring the current.

1. The wires on the frame being supposed to be of equal resistance, equal currents would flow in them, and the total current would be equal to the current in the galvanometer multiplied by the number of wires used.

$$C = n\,k \tan.\,\theta \quad \ldots \quad \ldots \quad \ldots \quad (a)$$

2. Supposing the wires not to be quite of equal resistance, then if m = the resistance in parallel circuit of all the wires used, when cold, and g that of the galvanometer circuit, when cold, then

$$C = \frac{g}{m}\,k \tan.\,\theta \ldots \quad \ldots \quad \ldots \quad (b)$$

3. The difference of potential at the terminals of the galvanometer circuit, being equal to the product of the current and the resistance of the wire at that instant, *i.e.*, when warm, or

$$E = C'\,g' = g'\,k \tan.\,\theta\,;$$

or if m' is the resistance of all the wires, when warm,

$$E = C\,m' \quad \ldots \quad \ldots \quad \ldots \quad (c)$$

The difference of potential, E, was measured by a condenser and reflecting Thomson galvanometer. Even if the wires are not equal (*b*) and (*c*) should give results which are very nearly equal.

German silver would have been preferred to galvanised iron for the wire frame, if it had been available, because of its more even quality, higher specific resistance, and smaller change of resistance for change of temperature.

There could be very little leakage from one wire to another, for the extreme difference of potential at the ends of the wires was only about 6 volts.

The external resistances used were (1) coils of coarse German silver wire arranged in multiple circuit, and arranged so that a portion could be cut out or short-circuited, to give the required resistance. Or (2) boards wound longitudinally with fine iron wire and laid over one another in a large tub, the ends being connected and the bights brought to the edge of the tub clear of each other. Water was allowed to run into the tub, and the circulation kept up during the experiments.

One end of the short cable was connected to one end of these wires, and the return main to the dynamo hooked into the bight at such distance as was required to give the proper strength of current.

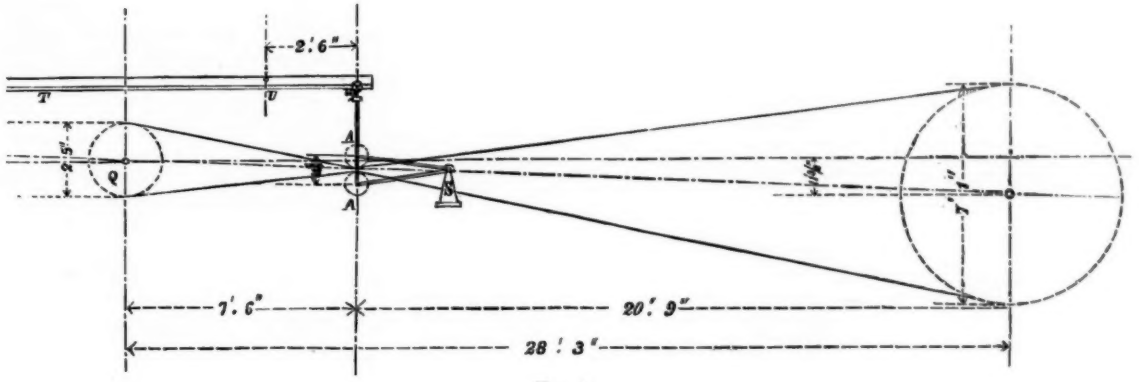


FIG. 1.

For higher resistances, the resistance of water between a piece of sheet-iron and an iron tube was employed.

The reflecting galvanometer, G (fig. 2), had a resistance of about 11,000 ohms, and the condenser, C, had a capacity of half a microfarad. H is a shunt, P a reversing key, and T a discharge key. During the later experiments an Edison incandescent lamp, L, was used instead of an oil lamp for the reflecting galvanometer.

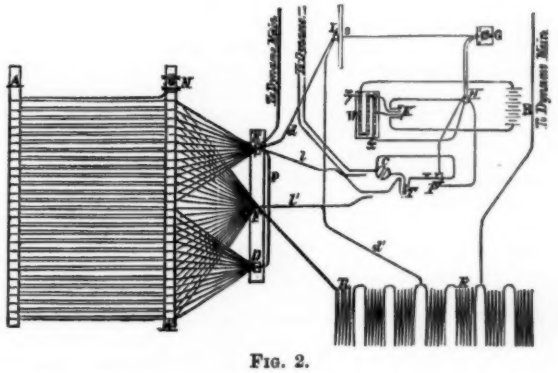


FIG. 2.

Clark's standard cell (E.M.F. = 1·457 volts) was used

for standard deflections, and compared with it a pint Grove's cell had an E.M.F. of 1·925 volts.

To determine the constant of the tangent galvanometer, a branch current from an "A" Gramme machine was sent through the thick German silver coil and the tangent galvanometer, and the difference of potentials at the terminals was taken by the condenser and compared with the standard cell, no shunt being used with the reflecting galvanometer in either case.

The mean of a great number of different determinations gave $k = 3{\cdot}469$ for the constant of the tangent galvanometer.

Three sets of readings of the dynamometer were taken :—

(1) For friction of shafting alone.
(2) For shafting and dynamo running free.
(3) For shafting and dynamo with circuit closed.

The resistances of the dynamos and of the branch wires, and the deflections given by the standard cell, were taken during the two first experiments, and the electrical measurements with the dynamo running were made during the third experiment. A relation was established between the deflections given with the different shunts of the galvanometer, by means of 12 Leclanché cells. After the standard deflections were obtained, the difference of potential at the brushes of the commutator or at the terminals of the external circuit were obtained, and then the difference of potential at the points E and F, the terminals of the galvanometer circuit. After this the engine was indicated, and the speed of the dynamo found ; then as soon as the current was broken and the dynamo stopped, the resistances of the armature and the field magnets were obtained.

Testing of Incandescent Lamps.—The lamps tested were—(1) Edison A 16-candle lamps ; (2) Edison B 8-candle lamps ; (3) Edison C 8-candle high-resistance lamps ; (4) Swan 20-candle lamps ; (5) British Lane-Fox high-resistance lamp ; (6) Brush Lane-Fox lamp. Six of each of these kinds were tested. Besides these there were also tested—(7) Maxim lamps ; (8) Swan small 10-candle lamps ; (9) Swan high-resistance lamps ; (10) Swan large 100-candle lamps. The efficiency of these lamps was tested, *i.e.*, the ratio of the quantity of light given by each lamp for each unit of electrical energy spent. The electromotive force was measured in two ways—(1) by discharge from the condenser ; (2) by a Thomson's voltmeter, and roughly by the number of Grove's cells employed. The current was measured (1) by Thomson's current meter ; (2) by a tangent galvanometer. The illuminating power of the lamp was measured on a Bunsen photometer, being compared with a lamp of about 17 candles, the accurate value being determined from time to time by careful comparison with a standard candle. The intensities were equalised in each case for red light and for green light (red and green glasses being employed), and the intensity of white being deduced from the mixture of red and green in definite proportions, according to the scale given by Captain Abney.

Through the kindness of Professor Guthrie these experiments were carried out in the Physical Laboratory at South Kensington, by Mr. F. J. Sprague, Captain Abney, and Professor Adams, assisted occasionally by Colonel Festing and by Mr. Pierce. The same condenser and Thomson's reflecting galvanometer and the same Clark's standard cell were used as in the experiments with dynamo machines. The current was obtained from a battery of Grove's cells, and usually each lamp was tested in simple circuit, with battery powers varying from 20 to 50 Grove's cells, the small lamps from 10 to 25 Grove's cells, the Maxim to 70 cells, and Edison high-resistance lamps were tested to 80 and 85 Grove's cells. The object was to determine the law of efficiency of each kind of lamp for different currents, and for illuminating powers far beyond the usual illuminating powers of the lamps. It was thought that this severe test would give also some idea as to the lasting power of the lamp. The resistances of the lamps cold were measured on a Wheatstone bridge, and were as follows :—

No.	Edison. B.	Edison. A.	Edison. C.	Swan.	British.	Brush.	Maxim.
1	154·2	272·8	455·7	63·0	163·3	34·3	80·2
2	124·8	226·1	578·5	85·0	156·8	36·3	79·9
3	158·5	248·1	472·4	67·0	157·7	31·4	84·1
4	135·7	204·1	483·6	69·8	158·7	35·1	79·9
5	115·0	275·1	476·6	72·4	153·8	32·6	86·0
6	118·6	219·7	446·7	67·6	154·5	38·2	84·2

Besides these there were tested—Swan high-resistance lamps Nos. 13 and 14 ; Swan low-resistance 8-candle lamps, Nos. 15 and 16 ; Swan large 100-candle lamps, Nos. 17 and 18.

NO. AND RESISTANCE.

13	14	15	16	17	18
194·0	186·2	26·4	20·0	47·8	53·8

An elaborate series of experiments was carried out by Mr. Sprague and Prof. Adams to determine the constants of the Thomson current-meter and the Thomson voltmeter. The constant of the current-meter was found by comparison with a tangent galvanometer whose constant was carefully determined, and the value was less than the value given with the instrument, in the ratio of 15 to 16. The value of the constant for the current-meter was ·150—*i.e.*, the reading of the instrument, when multiplied by this number, gave the current in ampéres. The value of the constant of the voltmeter was

$$\frac{7{\cdot}1 + {\cdot}18}{2} = \frac{7{\cdot}28}{2} = 3{\cdot}64.$$

The different graduations of the platform of the voltmeter were found to be consistent with one another.

The calculated results for some of the lamps tested are given in the following tables :—

As an illustration of the method of working out the characteristic curves for incandescent lamps, take the Edison "B" lamp, No. 4.

Resistance (cold) = 135·7 ohms.

For measurement of *current*—

$$\text{Constant of current-meter} = \frac{6{\cdot}54}{43{\cdot}6} = {\cdot}150 = \frac{3}{20}$$

Cells	20	25	30	35	40	45	50
Readings	2·9	4·0	4·8	5·95	6·9	7·95	8·7
Currents	·435	·6001	·7199	·8925	1·035	1·192	1·305

For difference of potential at the poles of the lamp—

(1) By Thomson's voltmeter.

$$\text{Constant} = \frac{7{\cdot}1 + {\cdot}18}{2} = 3{\cdot}64 \text{ (log. } 3{\cdot}64 = 0{\cdot}5611).$$

Readings	10	12·4	14·7	17·0	19·1	21·3	23·5
	1·0000	1·0934	1·1673	1·2304	1·2810	1·3284	1·3711
	0·5611	0·5611	0·5611	0·5611	0·5611	0·5611	0·5611
	1·5611	1·6545	1·7284	1·7915	1·8421	1·8895	1·9322
Volts ...	36·40	45·13	53·51	61·87	69·52	77·54	85·55

(2) By condenser and reflecting galvanometer.

Value of shunt 10·27, deflection for standard cell = 37·5

$$\text{Constant} = \frac{10{\cdot}27 \times 1{\cdot}457}{37{\cdot}5} = {\cdot}399 = {\cdot}4 - {\cdot}001.$$

Readings	92	113·5	135·5	157	178	199	219·5
Volts.....	36·71	45·29	54·06	62·65	71·03	79·41	87·58
Mean volts ...	36·55	45·21	53·78	62·26	70·27	78·47	86·56
Mean watts...	15·84	27·13	38·69	55·56	72·71	93·60	112·93
Kilogram-metres	1·614	2·765	3·943	5·660	7·407	9·536	11·50
Values of $\frac{E}{C}$	84·02	75·34	74·73	69·76	67·90	65·83	66·35
Candle power:							
(1) Red ...	·3412	1·843	5·302	13·760	27·21	46·58	79·00
(2) Green ...	·2673	2·050	6·034	17·500	44·65	79·00	143·70
Mean corrected candle-power	·3042	1·946	5·668	15·900	37·53	66·03	119·45

The characteristic curves, with ordinates representing candle-power and abscissæ representing kilogram-metres, are drawn for each lamp, and the mean of all the curves for the six Edison "B" lamps is the curve given in fig. 3.

Take, as another instance, the Swan high resistance lamps (No. 13). Resistance (cold), 194 ohms.

For measurement of *current*—

$$\text{Constant of current-meter} = \frac{6{\cdot}54}{43{\cdot}6} = {\cdot}150.$$

Cells	25	30	35	40	45	50
Readings	2·2	2·8	3·4	4·2	5·2	6·2
Currents	·33	·42	·51	·63	·78	·93

For difference of potential at the poles of the lamp—

(1) By Thomson's voltmeter.

$$\text{Constant} = \frac{7{\cdot}1 + {\cdot}18}{2} = \frac{7{\cdot}28}{2} = 3{\cdot}64 \text{ (log. } 3{\cdot}64 = {\cdot}5611).$$

Readings	12·4	14·9	17·2	19·5	21·6	24·0
	1·0934	1·1732	1·2355	1·2900	1·3345	1·3802
	·5611	·5611	·5611	·5611	·5611	·5611
	1·6545	1·7343	1·7966	1·8511	1·8956	1·9413
Volts	45·13	54·24	62·61	70·98	78·63	87·36

(2) By condenser and reflecting galvanometer.

Constant = ·399 = ·4 − ·001.

Readings	115	135	159	181·5	201·5	225
Volts	45·88	53·87	63·45	72·43	80·41	89·78
Mean volts	45·50	54·05	63·03	71·71	79·52	88·57
Watts	15·01	22·70	32·145	45·18	62·026	82·37
Kilogrammetres * ...	1·529	2·313	3·277	4·606	6·322	8·395
Values of $\frac{E}{C}$	137·9	128·7	123·6	113·9	102·0	95·21
Candle-power—						
(1) Red light	·6832	2·275	6·301	13·76	28·34	57·76
(2) Green light ...	·4638	2·275	8·806	19·72	44·65	82·75
Mean candle-power...	·5735	2·275	7·544	16·74	36·50	70·26
Corrections for white light	...	...	·180	·50	1·36	2·10
Corrected candle-power	·5735	2·275	7·734	17·24	37·86	72·36

Compare with this a low-resistance 8-candle Swan lamp (No. 15); resistance (cold) 26·4 ohms. For this lamp 10, 15, 20, and 25 cells were employed.

* = watts × ·10192.

Cells	10	15	20	25
Readings	8·3	12·3	16·5	20·5
Currents	1·245	1·845	2·475	3·075
Differences of potential—				
(1) By voltmeter	16·744	24·752	32·032	38·584
(2) By condenser method ...	16·359	24·339	31·920	38·304
Mean volts	16·551	24·545	31·976	38·444
Watts (EC.)	20·606	45·286	79·140	118·215
Kilogrammètres	2·1	4·62	8·072	12·057
Values of $\frac{E}{C}$ (in ohms) ...	13·3	13·3	12·9	12·5
Candle-power—				
(1) Red light	·5888	7·776	36·24	82·75
(2) Green light	·4264	11·260	63·10	149·40
Mean candle-power	·5076	9·518	49·67	116·07
Corrections	...	·300	2·70	7·40
Corrected candle-power ...	·5076	9·818	52·37	123·47

The characteristic curves for each lamp having been drawn, the curves of lamps of the same kind were grouped together, and the mean curve of each group is the characteristic curve for that group, and is represented in fig. 3 for the series of lamps tested.

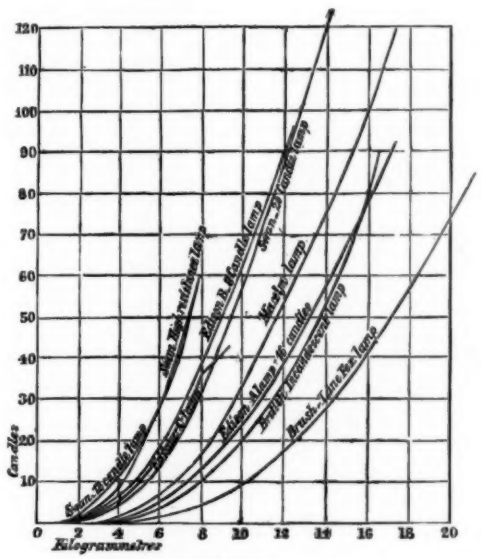


FIG. 3.

Relation between work expended and candle-power in Maxim incandescent lamps.

For measurement of current—

Cells	20	25	30	35	40	45	50	60	65	70
Readings.....	4·9	6·2	7·6	9·0	10·45	11·9	13·4	16·5	17·8	18·5
Current in ampères	·735	·930	1·140	1·350	1·567	1·785	2·010	2·475	2·670	2·775

For difference of potential at the poles of the lamp—

(1). By Thomson's voltmeter.

Readings	9·75	11·9	14·1	16·2	18·45	20·5	22·5	26·4	28·1	30·05
Volts	35·49	43·31	51·33	58·94	66·97	74·63	81·91	96·10	102·3	109·3

(2). By discharge from a condenser.

Readings.....	69	110	131	151·25	171·75	191·25	211	248	266	284
Volts	35·511	43·89	52·269	60·349	68·329	76·308	84·189	98·948	105·735	112·917
Mean volts ..	35·50	43·60	51·80	59·65	67·65	75·47	83·05	97·53	104·02	111·10
Watts	26·09	40·55	59·05	80·52	106·0	134·7	166·9	241·4	277·7	308·3
Kilogram-metres	2·659	4·131	6·016	8·204	10·80	13·73	17·01	24·60	28·30	31·42
Values of $\frac{E}{C}$..	46·29	46·88	45·43	44·19	43·16	42·29	41·32	39·41	38·95	40·03

Measurement of candle-power—

Red light	·4264	1·945	6·301	15·52	33·37	60·34	95·23	207·6	265·1	388·9
Green light	·2954	1·945	7·152	18·95	41·99	79·00	149·4	318·0	388·9	482·3
Mean	·3609	1·945	6·726	17·23	37·63	69·67	122·31	262·8	326·0	435·6
Correction.....	- ·01	..	+ ·06	+ ·25	+ ·61	+ 1·36	4·50	9·0	10·5	18·5
Corrected candle power	·3509	1·945	6·786	17·48	38·24	71·03	126·8	271·8	336·5	454·1

From the values of $\frac{E}{C}$ for Maxim lamps it appears that up to a little beyond 300 candle-power the resistance continues to diminish, but that the resistance for higher illuminations again increases, showing that from about 300 candle-power the breaking down of the lamp has begun, and the lamps break after attaining an illuminating power of about 450 candles.

The characteristic curve for Maxim lamps is not continued to the extreme value in fig. 3, but is of the same general character up to the point where it begins to break down. At 32 candle power there is a yield of 240 candles per H.P., as compared with 342 candles for Edison lamps, and 415 candles for Swan lamps. At 40 candle power there is a yield of 280 per H.P., as compared with 400 candles for Edison lamps, and 500 candles for Swan lamps. At 140 candle power the yield is 600 candles per H.P., *i.e.*, the economical efficiency is the same as the economical efficiency of Swan high-resistance lamps at 60 candle power for each lamp.

The efficiency of the Maxim lamp becomes about 920 candles per H.P. when the lamp is giving an illumination of about 300 candle power, and so is comparable with the efficiency obtained in lighting by the electric arc.

With the Maxim lamp the illumination was not equal in all directions on account of the flatness of the filament. At half a right angle from its position of brightest illumination, the candle power was reduced about 7 per cent., and near the plane of the filament the illumination was only about 75 per cent. of the brightest illumination.

AN IMPROVED GALVANOMETER.

THE Galvanometers hitherto devised for measuring the strengths of powerful currents have left much to be desired as regards reliability and non-liability to change from lapse of time. The instruments recently devised by Messrs. R. E. B. Crompton, and Gisbert

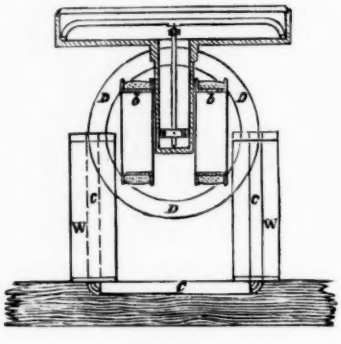


FIG. 1.

Kapp, appear absolutely to be depended upon as regards constancy for an indefinite period; and if properly calibrated in the first instance and used at a reasonable distance from the influence of the dynamo machines, they should also be perfectly accurate in their indications. Galvanometers whose "constants" are dependent on the permanency of a permanent steel magnet, we have always contended, cannot be relied upon. Messrs. Crompton and Kapp, in their new instruments, have avoided the use of this element of instability, and have employed an electro-magnet in the place of a permanent magnet, this electro-magnet being excited by the current whose strength it is required to measure. In designing their apparatus the inventors have taken advantage of the fact that a mass of iron is only capable of becoming magnetised up to a certain intensity, and that any current beyond that required to impart this maximum amount of magnetism would produce no increase of effect.

Figs. 1 and 2 show a recent arrangement of the new galvanometer. In fig. 1, C, C, C, is the core of the electro-magnet, W, W, are the coils exciting it and *s*, *n*, a magnetic needle, on an axle at whose upper end is

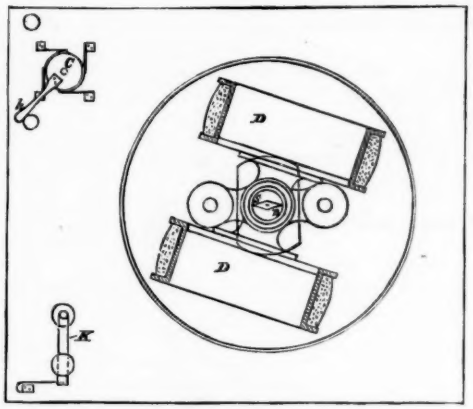


FIG. 2.

fixed a pointer. *b*, *b*, are coils shown in section surrounding the needle on either side, and joined up with the coils W, W. These coils *b*, *b*, are called the balancing coils, and the amount of wire on them, their position, and their size are so arranged that their effect on the needle is about equal or slightly larger but in sense opposed to the magnetic effect of the coils, W, W. D, D, are the deflecting coils. Another method of balancing the directing force of the coils of the electro-magnet is by placing the deflecting coil not exactly parallel with the zero position of the needle, but at such an angle to it that if the iron core be removed from the coils of the electro-magnet, and if the instrument be so placed in the field of the earth that the needle pointing north-

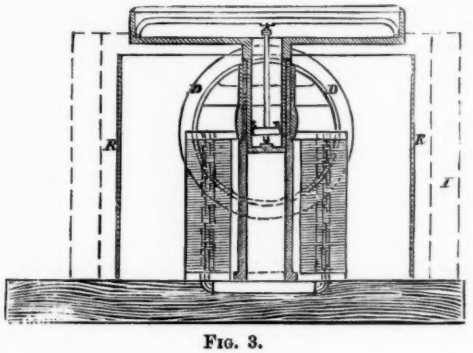


FIG. 3.

south stands at right angles to its zero position a current traversing the instrument will not deflect the needle from its position in the magnetic meridian. In this case the resultant of the forces from the directing coils and the deflecting coils acts at right angles to the zero position of the needle, or in other words the directing force of the coil of the electro-magnet is exactly balanced by the angular position of the deflecting coil. The angle at which the deflecting coil must be set, must be determined

experimentally. If the coil be fixed at this angle and the iron core of the electro-magnet be replaced, an instrument is obtained which indicates in a similar manner to an ordinary tangent galvanometer, and the scale or dial of which has to be divided in nearly the same manner as to that of an ordinary tangent galvanometer. In fig. 2, D, D, are the deflecting coils set at an angle as shown and for the purpose above described.

Figs. 2 and 3 show an arrangement of an additional resistance drum, R, R, a short circuiting key, K, by which this can be cut out of circuit, and a commutator, C, by which the direction of the current can be reversed. The dotted line, fig. 3 shows an iron shield which may be used to shield the instrument from external sources of disturbance.

Fig. 13.—Exterior View of the Vizille Installation.

THE ELECTRIC TRANSFER OF ENERGY.

Researches of M. Marcel Deprez.

Summary of Experiments.

By FRANK GERALDY.

Translated from *La Lumière Electrique.*

(*Continued from page* 329.)

About this time the municipality of Grenoble entered into negotiations with M. Marcel Deprez, The mountainous and pic-

turesque region in which the Department of the Isère is situate is extremely rich in waterfalls. Besides those which exist, an almost unlimited quantity might be created with little trouble and cost. All this force remains useless in consequence of its remote situation.

The municipality of Grenoble, intelligent and active, had for a long time been engaged with this question. Projects for bringing water to Grenoble at high pressure had been put forward. When the experiments on the Northern Railway were known, these gentlemen were desirous of learning whether the electric transmission of power might not serve their purpose. They asked M. Deprez to repeat for them, and among them the experiments already made.

Here was an opportunity offered under quite practical conditions, and it was accepted.

The machines which had served on the railway of the North

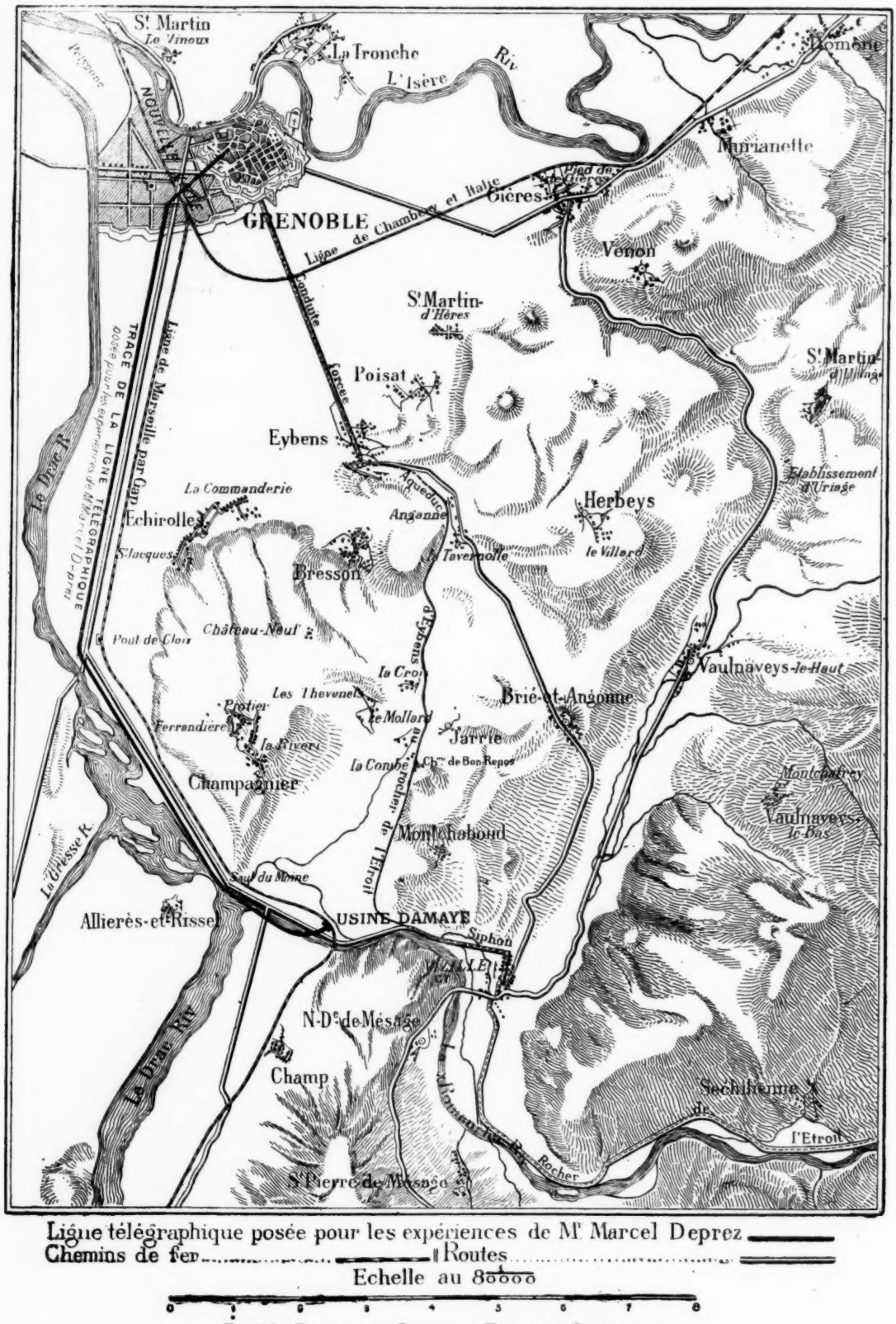


FIG. 14.—PLAN OF THE LINE FROM VIZILLE TO GRENOBLE.

were carefully examined; the generator was dried, the receiver was modified in several parts, especially in its magnetic field, which was much improved. When thoroughly put in order they were sent off to Grenoble, and with them went the engineer, M. Sarcia.

The first project was to set up the generator at Sassenage, about six kilometres from Grenoble. The arrangement of the fall of water not being suitable, what was needed was found near Vizille, at the point called the Bridge of Champs, at 14 kilometres from Grenoble. MM. Damaye & Co., of the cement works, offered to connect the machine with their turbine, and during the entire duration of the operations they, with much kindness, left it at the disposal of the experimentalists. Fig. 10 shows the arrangement. The turbine, by means of a bevel-wheel, worked a long transmission shaft. At the end of this shaft another was placed at right angles. Upon the latter was fixed the moving pulley, whilst a parallel transmission enabled the velocity to be multiplied and drove the machine. This twofold transformation was necessary to pass from the velocity of the turbine, about 140 revolutions per minute, to that of the machine, which was ten times greater. A view of the works with the arrangement of the turbine is shown in fig. 11. The turbine is supposed to be empty of water to leave it visible. The generator is on the first floor to the right, near the measuring-table, on which is placed a telegraphic station. This station proved useless, as will be mentioned below.

Fig. 13 shows the exterior view of the works, and the window by which arrive the conducting wires which carried the current from Vizille to Grenoble, and brought it back.

FIG. 12.

The circuit was composed of wires of silicium bronze of 0·002 metre in diameter. Fig. 12 shows them in their real size. As regards this installation there occurred a little incident showing the fears of the Telegraphic Administration as regards high tensions. Its authorisation was needed for establishing this line. It does not very clearly appear wherefore, since it did not pass near any of the telegraphic lines—but such is the law—permission was at first refused, the principal reason alleged being the danger, and secondly that currents of high tension might disturb the telegraphs merely by passing accidentally near their lines, and perhaps even by entering the earth in the same locality. The direct and instant intervention of the Deputies of the Department of Isère was needed for the reversal of this decision. (Red tape is not entirely wanting in France!) The line was laid by the employés of the Government. It has been said that the installation was "special." If this implies that it was made expressly for these experiments, it is quite correct. But if it is meant to say that it was constructed with especial care, it is entirely false. It was on the contrary, run up very rapidly, with old posts and very common insulators taken from the stores. The wires passed among trees, and the road being very narrow, there were possibly contacts with the leaves. In short, it was a very ordinary line.

(To be continued.)

NOTES.

Electric Lighting.—Messrs. Elphinstone & Vincent, in issuing their new prospectus and price list, avow their desire to place electric lighting more entirely in the hands of engineers, hoping thereby to prevent the recurrence of failures due to defective engineering. Their prices are so arranged as to admit of a liberal discount to engineers and merchants, and they remark, by way of explanation, that each arc lamp of 2,000 candle-power, and every 10 incandescence lamps of 20 candle-power each, require one actual horse-power of mechanical force.

The New York *Electrical Review* states that the electric light is now used in four churches in Montreal.

The Sydney papers of March 1st state that the lighting of the General Post-office by means of electricity has proved a great success. The time has now gone by perhaps for talking about "experiments" in connection with this comparatively new method of illumination. Its success may be said to have been already established beyond doubt, although, as with everything else, further developments and greater improvements will, no doubt, be made in the course of time. When first the light was started at the Post-office, under the direction of Mr. E. C. Cracknell, Superintendent of Telegraphs, no hitch of any kind whatever occurred, and on the night when all the lamps were fixed the effect was pronounced to be a complete success. Mr. H. H. Kingsbury, the agent for Edison's Electric Light Company, therefore formally handed over the paraphernalia to the authorities. The incandescent lamp, as arranged in the Post-office, is to the eyesight considerably softer than gas, and at the same time its penetrative rays are so directed that the sorters and operators have a considerably increased light upon their work, which must materially assist them in the performance of their duties. Our Australian contemporaries think that while gas must ever find a vast field for occupation, it may be hazarded that, so far as lighting is concerned, in a climate such as that, it will not be many years before it will be replaced by electricity, the light from which, as supplied by Edison's Company, is at once beautifully mellow and soft.

"As to lighting the New Municipal Buildings at Leeds," says the *Mercury*, "gas is laid throughout the building, although in the principal rooms of the library there are no fixtures, since it is proposed to stand or fall by electricity. Incandescent lamps of the improved Swan type are employed. The dynamo machines for generating the current are placed in the basement of the building, and will be driven by two 12-horse-power (nominal) self-starting 'Otto' gas engines, built on the most improved principle by Messrs. Crossley Brothers, Limited, of Manchester. In order to ensure perfect steadiness of working—sometimes a difficult matter when using gas motors—each engine is fitted with two very heavy fly-wheels, and the driving gear is attached not rigidly, but by a spring arrangement, so as to modify the impulse of each combustion of gas. The engines have moreover a very perfect form of governor, so that their action may be adapted to the varying work required of them. Messrs. Paterson and Cooper, electric light engineers, of Little Britain, London, are carrying out the electric lighting contract, under the direction of their resident engineer, Mr. Edwin C. Wallis. The dynamo machines to be used are of the improved 'Paterson & Cooper' type, and are self-regulating, so that groups of lamps may be turned on or off without affecting the others. For the present 284 lamps only will be employed, although the machines, if supplied with sufficient power, are capable of working double that number. In the ordinary way, when both machines are working, each will have to maintain only from 140 to 145 lamps; but in case of accident either one or the other may, without increasing the speed, have switched on to its circuit a number of additional lamps. The lamps throughout are placed on two distinct circuits, one from each machine, and so arranged that in case of the temporary stoppage of either machine no part of any room will be without light. Provision is also made for switching these circuits together, in order to work them from one machine if necessary. The mains and wires used in the work are of the best possible character, and every precaution—in the shape of fuses, &c.—will be adopted to prevent danger of fire through overheating of the wires. Each dynamo machine is fitted with a heavy fly-wheel, and is mounted upon massive frames of wood, with screws worked by a double ratchet in order to regulate the tightness of the driving belts. A very handsome 'switch-board' will be fixed near the machines, provided with safety fuses, main switches, coupling switches, and instruments for measuring the current and its electromotive force. In addition to these safety fuses and switches, 15 others are placed in lock-up cases in the various rooms at the points where branches leave the mains, and again in a large number of covered boxes, whence the separate lamps or clusters are supplied. The insulation of the wires is said to be of the best possible kind. The pendants, brackets, and other lamp fittings have been specially designed, and are being made by Messrs. Charles Smith & Sons, of Birmingham, the contractors for the other ornamental brass and iron work in the building. Though not now actually ready for lighting, the whole of the electrical plant and machinery is expected to be in working order in about a fortnight.

Messrs. Woodhouse & Rawson claim that their new filament lamps have an efficiency of 30 per cent. or more over those of Swan. A few more such percentages of improvement would soon make electric lighting a grand success.

For some time past the Portsmouth Dockyard authorities have had on loan from the Anglo-American Brush Electric Light Corporation, Limited, one of their "D_2" size compound-wound "Victoria" machines. After conducting several exhaustive trials of this machine, the authorities have purchased it for placing on board H.M. gunboat *Dolphin*, where it will be employed for working a search lamp of 25,000 nominal candle-power, or for lighting the interior of the ship with 100 20-C.P. incandescence lamps. The engine used will be a "Brotherhood" *of the most recent type*. The Anglo-American "Brush" Electric Light Corporation, Limited, has just supplied to Mr. Richard Miller, of Glasgow, two of their "Victoria" dynamos for lighting the s.s. *Mexico*. The larger of these two machines, known as the E_2 type, is intended for running 250 20-C.P. lamps at a speed of 550 revolutions per minute. The smaller, D_2 size, will be in use for driving the night or "police" circuit, when the majority of the lamps have been extinguished. For the police circuit about 100 lamps will be in use. Both the dynamos will be driven by engines constructed by Messrs. R. Napier & Sons, of Glasgow. These engines will be of the vertical type, and will drive the dynamos direct by means of an internally geared wheel. By this arrangement the floor space occupied by the engines and dynamos is economised; this, on board ship, is a matter of great importance, as the space available is so limited.

The Liverpool Electric Supply Company has recently erected new premises in Rose Street, Elliot Street, which comprise, in addition to spacious workshops for the manufacture of electrical fittings and apparatus, a complete central generating station, from which the electric light is supplied at an agreed rental to customers in the immediate neighbourhood. The principal rooms of the Grand Hotel have been lighted with more than 100 incandescent lamps for some time past, and the company has also contracted to supply a large number of lights to the Adelphi Hotel on the same system. The general arrangement of the Elliot Street works, says the *Liverpool Daily Post* of April 23, is very creditable to Messrs. Holmes and Vaudrey, the engineers of the company, who seem to have carefully considered every detail, and have produced an establishment well worthy of inspection, from the novelty and interest of its contents. They have also demonstrated the practicability of supplying electric lamps free from the flickering and liability to breakdown hitherto too frequently associated with electric lighting. This has been accomplished by combining the use of accumulators with the generating machinery, a principle of working introduced by Messrs. Holmes and Vaudrey into Liverpool, and which has been in most successful operation for some months at Eberle's Restaurant in Dale Street, and at the Corporation Free Library, and more recently at the large ball-room of the Wellington Rooms. Well-arranged stores contain an ample stock of all the fittings necessary to complete an installation. In the battery-room, in addition to the large storage cells used for the hotels, is a portable set of accumulators in neat wooden boxes, each about nine inches square. By means of these boxes the electric light can be supplied for temporary purposes; and in this way, at a few hours' notice and at moderate cost, a dining-room or ball-room can be lighted for one or more evenings, as may be desired. The main steam engine for driving the machinery is capable of supplying 700 incandescent lamps, and by means of the accumulators the number of lamps supplied at any given time can be materially increased. A spare engine of smaller power is available in case of emergency. A gas engine, with dynamo attached, is exhibited mounted on a self-contained timber foundation. Such an arrangement is very convenient, and suitable for a private house where only a few lights are required. The Elliot Street works may be inspected by anyone interested in the subject any afternoon between 3 and 6 o'clock, on production of visiting card.

Messrs. Thomas and Taylor, the laundry engineers, have recently had a 50-light compound Gramme dynamo installed at the Caversham Laundry, Reading. The work has been carried out by Messrs. Emmerson, Murgatroyd & Co., Stockport, and is a complete success. There being no gas on the premises, the works are entirely dependent on the electric light.

We have received the information that Messrs. Emmerson & Murgatroyd, of Stockport, have received a bronze medal and award at the Cork Exhibition, for their compound-wound "Gramme" dynamo, designed by their electrician, Mr. P. J. Charles.

The electric lighting of the Crystal Palace has been contracted for by the Gülcher Company; and three dynamo machines and seventy five arc lights were in place for the illumination of the two naves and transept on the evening of the opening of the International Exhibition. At dusk, says the *Standard*, the machines were started, and the generated currents turned on for the first time—no previous rehearsal for the testing of the circuits having been practicable. The lighting is of the simplest character, and economy has apparently been studied to the utmost extent. The machines are driven by the Crystal Palace Company's fine Galloway engine, and the general execution of this portion of the installation has a smart engineering style in its appearance.

Dangers of the Electric Light.—Referring to the accounts published of the cause of the fire on the *Rebecca Everingham* on April 3rd, the New York *Electrical Review* repudiates the assumption that "a falling particle of carbon from an electric light" was responsible for the mischief, and says: "The enterprising correspondent of the Associated Press, being called upon to *guess* what set this river boat afire, guesses it was a spark from the electric light. It being our turn to guess, we'll guess it was one of the 'niggers' smoking a pipe on a bale of cotton, and we'll leave it to any man not, as we said before, interested in gas stocks, and knowing something about the relative danger to cotton from sparks from a voltaic arc light and coloured 'puss'ns' smoking pipes, if our theory of the cause of that fire is not more logical than that advanced in the afore-quoted dispatch."

Gülcher Electric Light & Power Company, Limited.—A petition for confirming a resolution reducing the capital from £300,000 to £150,000 is now pending. The list of creditors of the company is to be made out as for the 19th of May, 1884.

Pyramid Electric Company, Limited.—A petition for the winding up of this company, presented on the 27th March, by Bernard Le Neve Foster, of Yard Farm, Ewhurst, near Guildford, secretary of the company, and Francis William Thomas Brain, colliery manager, of Drybrook, Forest of Dean, the liquidators of the company, will be heard before Vice-Chancellor Bacon, to-day.

J. B. Rogers' Electric Light and Power Company, Limited.—A petition for the winding up of this company has been presented by Walter T. Glover & Co., of Manchester, electrical wire manufacturers, and is to be heard by Vice-Chancellor Bacon on the 3rd of May.

An Electric Ballet.—"Chilperic" at the newly-opened Empire Theatre in Leicester Square, is produced with a greater combination of imposing effects than has probably ever before been witnessed on the English stage, and the result is truly gorgeous. Not the least interesting of the many novelties is the introduction of an "electric ballet," in which 40 ladies appear, each with an aggregate of ten luminous points, effected by an arrangement of the Trouvé electric jewels

on helmet, spear, and shield. The lamps are connected by invisible wires with a small battery carried on the person of each performer; the batteries containing sufficient energy to last an hour. This department is under the personal direction of Mr. Armand Levy, of 252, Goswell Road, who states that a single switch is so contrived as to turn on or off the whole system by a single movement. We purpose giving an illustration of these jewels in a future issue.

A New Electric Motor.—Charles F. Brush, the electrician, with his assistants, is, states our American namesake, perfecting a new electric motor at the Brush Electric Works, to be used on street cars. The motor, which is to be stationed on the front or rear platform of the car, and there manipulated at the will of the conductor, is to be supplied with power from the Brush storage battery. The work of laying tracks for experimental purposes is almost completed.

The French Scandal.—The principal actors in the "domestic drama" which has recently attracted so much attention in Paris will doubtless be recollected by many persons connected with electric lighting in this country. MM. Savary and Lamy came to England some time ago in the interests of an electrical company, and made themselves known in quarters where they had reasonable hopes of disposing of shares. A telegram from the Paris correspondent of the *Daily Telegraph* on Monday contained the following particulars:—"Some unfavourable light is thrown upon the antecedents of M. Savary the ex-deputy, fired at the other day in a restaurant by M. Lamy, whose wife he had taken away. The magistrate charged with the duty of investigating the matter has seized several letters which passed between M. Savary and Madame Lamy, as well as between the ex-deputy and other persons connected with him in the establishment of companies of a rather shady character. The Company of Electricity was started by M. Savary at Lyons, whence it was transferred to St. Etienne. At St. Etienne Savary hired a shop next door to the branch office of the Crédit Lyonnais, and here he first installed an exhibition of pictures and artistic curiosities. Hither came, soon after, a staff of persons to assist in the work connected with the exhibition, these consisting of a Belgian engineer named Eck, an accountant, M. and Madame Lamy, and several special workmen. The exhibition was magnificently illuminated by electricity every evening, and attracted great attention at St. Etienne. Some days afterwards M. Savary issued shares in his company, but, although a good many persons put down their names as subscribers, no one deposited any money at the chief office of the Electrical Power Company, with the exception of one woman, who entrusted M. Savary with 175f., which she saw no more. The premises of the sham company at St. Etienne are now empty, but M. Savary's creditors have seized whatever goods they found in the place, and he has been ordered to resign his office of mayor of a commune in the Manche, which department he formerly represented in the Chamber of Deputies."

Lecture.—Mr. A. Reckenzaun was announced to lecture on the evening of Thursday last, at the Town Hall, Poplar, the subject being Electricity; its application to marine engineering, lighting ships, motive power, and signalling.

The Mackay-Bennett Cables.—We learn that the cable steamer, *Faraday*, left the river on Monday morning for a fresh attempt at laying the above cables.

The Earthquake.—We are informed that during the recent earthquake no "earth currents" were observed on the telegraph lines in any part of the country, a circumstance, we believe, most unusual in such cases.

Telegraphy.—The *Times* states that the Postal and Telegraphic Convention between Turkey and Bulgaria was signed at Constantinople on April 23rd.

Postal Telegraph Works.—Mr. Fawcett, in reply to Dr. Cameron, on Tuesday, said that £180,000 was expended during the last financial year on new postal telegraph works rendered necessary by the contemplated introduction of sixpenny telegrams. No increase in the staff would be made in consequence of the contemplated reduction; but a few "learners" had been taken on, and there was no intention of dismissing them.

Overhead Wires.—We understand the Government have decided to ask for the appointment of a Select Committee of the House of Commons to examine into and report upon the whole subject of overhead telegraph and telephone wires. It is believed this step has been taken at the instance of the Post-office authorities.

Shetland Telegraph Extension.—Intimation has been received from the Postmaster-General to the effect that in connection with a reduced tariff for telegrams, it is intended to lay a new cable between Buckie and Shetland; but as the commencement of the reduced tariff has been postponed the new cable will not be laid this year. It is further stated that it will not be desirable to loop the cable into the Fair Isle on account of the strong current and exposed nature of the place.

The Telephone in Canada.—The editor of the *Western Gazette* (Yeovil) has recently returned from a tour through the United States and Canada, and is publishing in his journal an account of his experiences. With regard to Toronto, he says that, "In some respects it is far ahead of many larger and older English towns," and continues, "The use of the telephone is a case in point. The telephone wires appear to enter almost every decent house, whether business or private. The district of the Toronto Telephone Company includes, moreover, a vast deal besides the city. The convenience, as well as the marvellous character, of this system of holding a conversation with a distant person will be well illustrated by the following story: My travelling companion had relations in Toronto, and together we visited them at their house—a private one in a quiet street. My friend happened to express a wish that he could arrange for another relative of his, living in a town about 35 miles from the city, to come in and see him. The lady of the house said: 'Oh, I'll call him up;' and, going to her telephone, she was in a minute or two in direct conversation with him. 'Mr. S—— is here,' she said, 'and wants to know if you can come into town and see him?' In a few seconds the day and the train were fixed, and at the appointed hour the gentleman duly turned up. When the Bristol people can thus speak to their friends at Bridgwater or Yeovil, when Exeter can talk to Axminster, and Southampton to Bournemouth, our important towns will be up to the level of Toronto in this particular matter. At present, we are all behind, and I am afraid we shall retain that position until the country insists on it that the Post Office, and the monopoly it claims in the use of electrical communication, shall no longer bar the path of progress. It is not the large American towns only which have the benefit of the telephone. I was in several places of from 5,000 to 15,000 inhabitants, in which every respectable house and every business establishment had its telephone. At a third-rate hotel at Marquette, an outlandish place on the shore of Lake Superior, 400 miles north of Chicago, I heard the proprietor's wife 'call up' one of the other hotels to inquire about a missing umbrella. I found in other places, not much larger, that the ladies were accustomed to do their shopping by telephone. They 'called up' in succession, their 'butcher, baker, and candlestick-maker,' and gave their orders without leaving their sitting-rooms. When are we going to do this in England? If Parliament would only authorise Mr. Fawcett to stand aside, even at some little sacrifice of Government rights, we might do it very soon, and at a very moderate cost."

Penny Telephonic Messages.—The following letter is stated to have been addressed from the Postmaster-General to Mr. John W. Batten :—"General Post Office, April 15, 1884.—Sir,—Sir Charles Dilke has forwarded to Mr. Fawcett your letter of the 3rd inst. asking permission to try the experiment of penny telelogues or messages from one part of London to another, say from Cheapside to Charing Cross. Mr. Fawcett presumes that what you propose is to open offices at Cheapside and Charing Cross, to connect those offices by wire either direct or through the Telephone Exchange, and to permit any member of the public to send from either office by telephone a message which is to be written down in shorthand at the receiving office and then delivered by messenger; the message, however, instead of being delivered in an envelope, as in the case of an ordinary telegraph message, to be simply read out to the addressee by the delivering messenger. If Mr. Fawcett has correctly apprehended your proposal, he is unable to see that it differs essentially from the ordinary system of telegraphing; and messages transmitted in this manner would be telegrams within the meaning of the Telegraph Acts. Such being the case, it would be illegal to charge for such messages at a lower rate than that fixed by the Telegraph Acts; and therefore, without in any way discussing the merits of your suggestion or examining the figures you have submitted to Sir Charles Dilke, Mr. Fawcett regrets that he is unable to assent to your application.—I am, sir, your obedient servant, C. H. B. Patey."

Royal Society of Edinburgh.—At the ordinary meeting of the Royal Society of Edinburgh, held on Monday last, Sir William Thomson presided, and there was a large attendance. Prof. Helmholtz, Berlin, an hon. fellow of the society, read a paper on "Galvanic currents passing through a very thin stratum of an electrolyte." Electrolytic decomposition, must, he said, go on till the required amount of gases is dissolved in the fluid, if there was not already a sufficient quantity of one of the gases, viz., oxygen, of the atmosphere in solution. The thermodynamic inferences which he had lately developed showed that a limited quantity of the gases could be produced electrolytically, even by very feeble electromotive forces, till a certain value of density of the dissolved gases, corresponding to the value of the decomposing force, had been reached. Out of these thermodynamic laws one could develope a complete mathematical theory of galvanic polarisation and its effects. As far as the accuracy of his measurements reached, the facts appeared to be in sufficient harmony with such a theory. The Abbé Renard, Brussels, who spoke in French, gave an examination of dust collected in the snow by Mr. Osmond at the Ben Nevis Observatory, and stated that he found the dust composed of small particles of coal, quartz, feltspar, and organic substances, from which he argued that so much organic substance could not possicly be of cosmic origin. A short discussion followed as to the possible inter-communication with life of different planets. Prof. Cremona, Rome, who aslo addressed the meeting in French, gave a method of deriving from the plane figure the generation and properties of a curved surface. The gentlemen were heartily thanked for their papers.

The Telegraph Service.—Mr. Fawcett, in answer to Dr. Cameron, on Tuesday, said that the question of introducing certain modifications into the form in which the telegraph account, made upon commercial principles, had hitherto been presented to Parliament, was now engaging the attention of the Treasury, and this would cause some delay in the account to be presented; but it would be possible by the end of next month to give the balance of profit to the end of the financial year. He might state that during the past year 32,732,000 telegraph messages were sent, showing an increase over the previous year of 640,000, and the increase in that year over the preceding year was 746,000.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Anglo-American Brush Electric Light Corporation, Limited.—The annual return of this company, made up to the 20th of February, was filed on the 16th inst. The nominal capital is £800,000 in £10 shares; 13,751 shares have been issued as fully paid, and upon 26,949 shares a call of £8 per share has been made. The calls paid amount to £352,186, leaving £916. The paid up capital, is, therefore, £7,180 in excess of the amount recorded in the last return, £4 per share having been called up on the partly-paid shares during the year.

Incandescent Electric Lighting Company, Limited.—At an extraordinary general meeting of this company, held at the New Square, Lincoln's Inn, on the 14th ult., it was resolved to dispense with Table A of the Companies' Act, 1862, as regards the management of the company, and to substitute in lieu thereof, special article of association. It was also resolved that £100,000 of the capital of the company in 20,000 shares of £5 each be appropriated as a separate capital for the purpose of the undertaking authorised by the Birmingham Electric Lighting Order, 1883, such capital to be known as the Birmingham Capital. These shares may be issued as 7½ per cent. preference shares. These resolutions were confirmed on the 2nd inst., and were filed on the 19th inst.

Telephone Company of Egypt, Limited.—The annual return of this company, made up to the 14th inst., was filed on the 19th inst. The capital is £100,000 in £5 shares. 12,071 preferred, and 4,000 deferred shares, have been issued, upon each of which £5 has been called, the calls paid amounting to £80,355. The paid up capital is £20,355 in excess of the amount recorded in the statutory return. Registered office, 3, Great Winchester Street, E.C.

Electric Apparatus Company, Limited.—An agreement, dated 10th inst., and filed on the 16th, ratifies and adopts an agreement entered into by Mr. James Boyd, of 7, Nicholas Street, Bristol, on behalf of the company, on the 21st February, for the purchase, from Mr. Charles Binswanger, of 4, Trafalgar Buildings, Charing Cross, of certain electric apparatus, and also for the purchase of the business carried on by him, the consideration being £6,000 in fully paid shares. The stock in trade of Mr. Binswanger will be purchased by the company at the nett cost price, less a discount of 10 per cent.

CITY NOTES, REPORTS, MEETINGS, &c.

The Electrical Power Storage Company, Limited.

THE annual general meeting of the above company took place on Wednesday last, at Cannon Street Hotel, Sir Daniel Cooper, chairman of the company, presiding. The Secretary read the notice convening the meeting, and the last minutes were also read and signed by the chairman.

The Chairman said :—Since the last annual meeting the company has not prospered. The balance sheet shows a considerable loss on the year's working, and a heavy expenditure in relation to maintenance and up-keep of patents, and also in connection with negotiations for their sale. I place in contrast the position of the electrical world when the company was formed and its position at the present time. The company has foreign patents which they hope to realise favourably, more particularly in America, as Mr. Courtenay, one of the directors, will explain, he having just returned from a lengthened stay there. As to France, the position is, as the board is advised, a secure one for the company. Having given brief particulars of some of the complicated negotiations which had taken place, the difficulties which had to be overcome, and the means by which this was achieved both in Paris and in Brussels, the Chairman continued :—Another unpleasant matter is the action of a portion of the shareholders of the Indian and Oriental Company. The company always has been most desirous to foster and support that company, and to deal with it more than liberally. In that spirit the patent for the cone type battery was offered to the Indian company without payment, and the directors accepted the proposal with acknowledgments of the liberal treatment they were receiving in the

a fixed royalty, with a lump sum down, in anticipation of the first royalties. They are now working our accumulators in an installation, and in August they have to announce their decision. This is one of the fruits of the Vienna Exhibition, and may recoup some of the outlay there. The company exhibited at Vienna rather reluctantly, but we had to face two important considerations—the first, that coming after the Paris Exhibition, we had never displayed on the Continent; and, the second, that the company's agent on the Continent maintained it was useless hoping to effect a patent sale there unless we did exhibit. If the immediate result has not been to bring profit, it has certainly brought reputation; for the tests made by the commission are thoroughly satisfactory, and bear out the claims made as to efficiency. In the two countries of Europe where there exists no patent protection, viz., Switzerland and Holland, license arrangements have been entered into with the two leading electrical firms, they being respectively Mr. Emil Bürgin, the inventor of the well known Bürgin dynamo, and the Netherlands Electrical Company. The installations made by the company have been of two classes. Those that are paid for outright on completion, which are very satisfactory, and of which the company want to get as many as possible, and those which are really lighting contracts, where the company find all the plant and material, and the customer only pays the rent. The experience of the board with regard to the latter installations does not encourage them to go on with this kind of business, as the cost in material and labour in putting up an installation is very great, and if the person for whom it is made fancies he can do better himself, or, through trade rivals, he gives notice that he will not continue the installation unless on his own terms, which are generally far under cost price. The company, then, finds itself in a dilemma of either having to make a heavy annual loss or a heavy loss at once, amounting to nearly the full cost of the installation. The Grand Hotel was instanced as a case in point. The contract was made at a time when the company required to have a show installation, and the electrical world were committing suicide by talking of "under gas rates" for electric lighting. The terms made were thought to be good; and, doubtless, with more convenient and economic motive power, would have been satisfactory. But gas engines of large power, kept very constantly at work, give much trouble, and cost a great deal. The proprietors of the hotel, Messrs. Gordon & Co., saw all this, and hoped to find steam motive power outside, and for a time they were negotiating with the company to light their enormous new hotel, the "Metropole," also, when it was finished; but they could not manage what they hoped as to steam power, and when they asked for a price for the future for the Grand Hotel alone, we quoted a profitable one to the company. But Messrs. Gordon & Co. thought they could do better. The company preferred to make a large loss at once instead of an annual one with the certainty of a large one whenever the contract might terminate; and so the installation was given up by the company. Messrs. Gordon & Co., however, were perfectly satisfied with the company and its work, and have written a cordial letter to say so. In theatre lighting the accumulators are doing very well indeed, as anyone may see either at the "Gaiety" or "Prince's" Theatres in London, and others are expected. But the installation which the board look at with most satisfaction is the Bank of England. We began there cautiously with one principal part of the building as a test, and I am proud that this lighting was entrusted to this company, because the Bank made careful investigation and found ours to be the only system fulfilling the Bank's stringent requirements. The installation has been running without a hitch; everybody is pleased; and the Bank has taken it over and paid for it, and we look forward to make an installation for them on a far larger scale for next winter. Another small matter in itself is the business commencing in temporary lighting of ball-rooms, evening parties, lectures, &c. It pays well in itself, but is of still greater use in bringing the value of electric light well before the right people. Railway-train lighting is just being brought into use, and if it prove as successful as those who have invested their money in it anticipate, it will be a great help to the company. The system adopted is the Stroudley-Houghton, in which accumulators are used. It seems to be reliable and economical, and if it once takes, the business will become very extensive. As regards the employment of accumulators for motive power, the success on land has been moderate, but on water it has been great. Thanks to the very spirited co-operation of the eminent shipbuilders, Messrs. Yarrow & Co., the little boat, the *Electricity*, was followed up by an elegant launch of good dimensions, which formed a leading attraction at the Vienna Exhibition, and before its departure was seen several times on the Thames. It worked admirably and met with great praise on all hands. There has been, however, great progress made on the Continent in land locomotion, the benefit of which must inevitably accrue to this company. Referring to the announcement with regard to the cone type of battery, it need only be said that the company has now acquired this free from any personal ties or incumbrances. This has only lately been achieved, and the company are, consequently, only now undertaking experiments on their own account. It can be said, however, that as regards this type, and also the clamp type referred to in the report, as designed by Mr. Sellon, there is reason to expect they will do useful work, and help to develop, each in its way, the business of the company. After referring to the accounts which accompanied the report, the chairman gave an explanation of the proposed reduction of capital, the effect of which would be to give one £1 share for every two £2 shares; and it was pointed out that as the capital was fully paid, it really was immaterial to the shareholders what the nominal amount of each share was. It has been said, continued the speaker, that by reducing the capital in the way proposed, each shareholder has had 20 shillings taken away from him and five shillings given in return. and that therefore the patents have been reduced by the like amount. I beg to differ from that statement. A sovereign with 20 marked on it and a five shilling piece with 5 on it are fixed and known quantities, but a share certificate with 20 or 5 marked on it is an unknown quantity, and whether the certificates be marked 20 or 5 will make no difference in realising the patents, which may, when disposed of in detail or in block, give an amount to allow 50 shillings for each share; or, if things turn out badly, sixpence, or nothing at all. In view of putting the expenditure on the most economical basis and to suit the means and reduced capital of the company, the directors have carried out sweeping reductions at the works and propose judiciously still further to do so. Mr. Bullivant, and Mr. Volckmar, the managing director, have resigned, and it is not proposed to fill up their seats; but Mr. Courtenay has agreed to act as managing director, and other consequential arrangements as to the staff will be made. I entertain a strong view that it may be to the interest of the company to introduce fresh blood at the board, and to permit this to be done Colonel Steuart and Mr. Ladd have very kindly stated their willingness to retire if two gentlemen can be found who, in the opinion of the shareholders and the board, would strengthen the directorate. What is wanted is men of well-known business habits and of high standing. The almost total failure of the customers to whom the company had a right to look for business, leaves no course open for it but to enter into general electrical work, and henceforth they will be prepared to tender for the erection of complete installations in all parts of the country, and for the production of any electrical machinery for which they can obtain profitable orders. The works of the company are absolutely suited for such a purpose; they have been excellently laid out, and are capable of doing an immense amount of business. One thing the company can say with great satisfaction is, that the workmanship of all the company's goods, whether accumulators or otherwise, stands in the highest repute, and it is intended to maintain that character. That, gentlemen, is all I have to say on behalf of myself and my colleagues, and I will only formally move that the report and accounts as presented by the directors, be received and adopted.

Mr. Sellon: I rise to second the resolution which the chairman has just put before you. He has at some length put before you the present position of the company. In some respects it may be admitted that this is not a satisfactory position, and the hopes which appeared fully justified at the time they were expressed last year have not been fulfilled; partly from uncontrollable causes, partly from causes which, could they have been foreseen, could possibly have been to some extent combated. Those of you who have been sufficiently interested in the development of electric lighting to closely follow and watch its progress, will have gathered that many difficulties, unavoidable difficulties, and hindrances have surrounded it. Few of you, I venture to think, who have been brought face to face with these difficulties can possibly realise in the faintest degree how great they have been; how at times they have appeared most disheartening and almost insuperable, and yet it is scarcely open to doubt, I think, that a future far greater than the most sanguine of us had foreshadowed for the utilisation of electrical storage, which is daily becoming so much better understood, and so much more readily available, must open up. You all know that the position hitherto of that development has been of a very curious character. There have been the combined forces of prejudice, ignorance and speculation, all brought to bear against it, and above all the vehement interested opposition of the vast gas interests which permeate every local and every municipal body throughout the kingdom. And yet these elements of opposition can, I think, in the long run, do no more than delay its inevitable progress. At the same time harassing and needless difficulties have been brought into opposition to us in addition to those inseparable from every new industry and every new discovery. In addition to those elements of difficulty which I have alluded to, the Electric Lighting Act, promoted by the Board of Trade, has not only added considerably to the expenses of those struggling against these difficulties, but has done its best to strangle an important industry at the start, under the plea of preventing monopolies such as those which exist for water and gas. Of course the unforeseen and unexpected retardation in the development of electric lighting has brought about circumstances most disastrous to the special business of supplying the users of storage batteries, and the disadvantages of being so greatly dependent upon work which has been carried out by those, has been very apparent to us. But the tide is turning, and there is full confirmation of the experience established last year, that no perfect system of electric lighting can be carried out without the use of storage batteries. Many of you have no doubt been perplexed by the constant announcement of new patents for storage batteries, and of new discoveries which were said to supersede in an extraordinary way those that had gone before. One day it was a primary battery, next day a secondary battery. In my opinion, however, the patents that we hold cover the whole ground so far as the economical storage of electrical energy is concerned, and we need have no fear in respect to those patents. No primary battery can possibly enter into the field which we cover; and, more than that, I would venture to say that the death knell of primary batteries in the most important of the

matter of the accounts between the companies for goods supplied also. Notwithstanding this, a small section of the Indian company's shareholders adopted a course which did not only that company, but this one, an immense amount of injury. All accounts, however, were adjusted between the two companies, and the last £5,000 cash due from the Indian company has been paid. The Australasian company sought to rescind a contract we made with Sir Julius Vogel for an option to purchase our patents. The verdict went against them, and they appealed; but the Lords Justices decided against them, and no further trouble need be apprehended on that score. In Germany the German Edison Company have made a contract which is, however, purely provisional, and gives them the right to a sole license for Germany at works for which they are now adopted is already sounded—for use, namely, in the telegraphic service in large centres. And as to the numerous secondary batteries which have appeared, I do not think that one in the whole range of them interferes with us. With respect to the present position of the accumulators, I would say that they have attained a degree of electrical efficiency so large that there is small margin for improvement. You may readily understand this when I say that from 90 to 95 per cent. of the energy received from a dynamo machine can be drawn off from them, and that 80 per cent. can be considered as available and effective for work, the residual 10 or 15 per cent. remaining in the batteries, and not having to be replenished on each occasion of charging. In the matter of durability, great progress has been made. The experience gained points to the possibility of future improvement in this respect, as also to very considerable decrease in the cost of manufacture. I think I may say that the directors have all unabated confidence in the future of this business. As the chairman explained to you, a large field is likely at once to open out for the use of accumulators in railway lighting, and in spite of all the difficulties enumerated, we may look, I think, to an almost immediate development, not for lighting only, but for motive power and heating, of a character to ensure satisfactory results. With regard to heating, a patent will be taken out which is likely to give a great impetus in that direction for railway carriages, for school-rooms, and for many useful purposes. In regard to motive power, a gentleman whose name is well known in connection with electrical storage, Mr. Reckenzaun, has elaborated a scheme based upon most minutely and carefully worked out details and figures, which, if I could put them before you, would at once inspire you with confidence as to the great future in that direction. At the same time we must confess that the work here engaged in is one which demands patience and perseverance, as well as the co-operation and good will of all those who are interested in it. This I beg you to accord, and I feel sure that the due reward of our united efforts in such a really great and useful work will in the end come. (Hear, hear.) I beg to second the motion that the report, together with statement of accounts now submitted, be received and adopted.

Mr. Courtenay: You were made aware, gentlemen, by the chairman's speech of last year, of the position of the company in America at that date. In June last I went out again to supervise the company's interests, and to conduct the litigation referred to by the chairman as then pending in New York, and to consult with the company's patent lawyer at Washington in the heavy contest which is going on in the Patent Office, and which involves the principal patents of the company in the United States of America. You know that patent procedure in America is quite different from what it is in this country. We are protecting on the one hand our issued patents, among which are some of the Faure patents, the Sellon patents, and others, against piratical attacks by numerous inventors, who are endeavouring to get patents for inventions which we contend are already covered by the company's patents, while on the other hand we are making application for patents which have for their object improvements in the secondary batteries manufactured under the patents we have already obtained. The American patent for Mr. Gustave Philippart's cone battery was obtained during my stay in the States, and is now owned by this company. In a word, we are building up a valuable series of patents in the United States, and covering all important points. I say we, because as you are aware, this company, though it has transferred its American patents to an American corporation (the Electrical Accumulator Company of New York, receiving fully paid stock in exchange), holds the controlling interest in that corporation. Thus much, then, for that branch of our work which deals with the patent litigation in the Patent Office at Washington. Some of you may not know that under the American Patent Office system these contests often last for years. I cannot leave this subject without adding my testimony to the skill and watchful care bestowed upon the patent suits at Washington by the gentleman who is defending the patents there, I mean Mr. Anthony Pollok. I now come to a delicate topic, namely, the pending litigation in New York. I cannot without injury to the company's interests give full details upon this head. At the meeting of the company last spring, during my absence, a report of explanations made to the shareholders was sent to New York, and was there made use of in court to our detriment. I don't propose, with your permission, on this occasion to furnish our adversaries with any materials that can be of service to them. You will remember at that meeting it was stated that we were in litigation with the Light and Force Company of New York, in whom the Faure patent for America was originally vested, and that we claimed 49,000 shares of stock, of the nominal value of $4,900,000. I stopped that litigation, and without going into further details, I can assure you that the Light and Force Company of New York, which once was hostile, is now a friendly corporation. It has its abode at the same office as is occupied by the Electrical Accumulator Company of New York, at 78 and 80, Broadway, where also our legal advisers, Messrs. Parrish and Pendleton, who so well represent this company, have their office. There is an installation there of our accumulators, which is quite creditable, considering the many difficulties. The further litigation, which is still proceeding, is against several sub-companies and individuals for stock and interests in the Faure patent, which they claim to have become entitled to through the Light and Force Company. These claims are most extortionate, and must be resisted. They are the outcome of numerous and very complicated transactions, entered into before my first visit to the States on the company's business, and during the period when the Light and Force Company was hostile. A trial, lasting for several days, has taken place, but the judgment has not as yet been given. We have been, and are ready, to negociate a settlement on fair and reasonable terms, but we shall not make any compromise that is not just and equitable. The expenditure in America is chiefly made up of the outlay in connection with the above proceedings. The third point in connection with the American business is how best to deal with our interests in that country, which are practically represented by the stock we hold in the Electrical Accumulator Company of New York. The nominal capital of that company is $5,000,000, and I have already said we hold the controlling interest. Negociations were in progress to bring into the business some of the most substantial and shrewd business men in the United States with a considerable amount of American capital, and these will be continued; but serious injury was done by the persistent efforts made to impair our title to the Faure patents, and by notices published in the New York papers and other methods, while the published reports of meetings in this country of people interested in our system of secondary batteries were most damaging. Some work in the way of installations has been done there, and I hope soon to hear of more. The complications I have mentioned have seriously checked the development of the business, but one of the offshoots of the Light and Force Company, commonly known as the Baltimore Company, had nearly completed a new factory when I left. There is great interest taken in secondary batteries in the United States, and there is no question as to the immense field for the business of the company. I shall now conclude my remarks on the American business with an expression of my opinion, that if vigorously and judiciously followed up it will prove a very profitable investment. On my return to this country, a few weeks ago, I learned that serious complications had arisen in connection with the contract for the sale of the company's patents to the French Electrical Power Storage Company, Limited. You will have observed the note appended to this item in the patent sales account. The bankruptcy of the French Storage Company has been declared in Paris, and it is now in the hands of a syndic, an official who in France practically corresponds to a liquidator in this country. The French Storage Company has failed to carry out its contract with us, and the patents therefore revert to this company. I was asked by the directors to look into this matter, and have, in consequence, paid several visits to Paris to consult with our legal advisers in France. A brief report has been received. I will read it. We are now in communication through them with the Syndic, and at the moment it is not politic to say more upon that subject.

Mr. Dever, on behalf of the auditors, submitted a paper dealing seratim with the items of the balance sheet presented to the shareholders. In that document the auditors said: The capital account, the first item in the accounts, consists solely of the capital account as at December 31, 1883, after the redemption of certain surrendered shares as referred to in the directors' report. The items of debts owing to the company come next. We are assured by the directors and by the officers of the company, that this total represents the total indebtedness of the company. The patents account balance will be found to be the result of the separate account called the patents sales account. That patent sales account commences on the credit side with a sum of £346,930 as brought forward from the accounts December 31, 1882. To this credit has been added £48,750, being the additional amount of the second contract for the sale of the French patents, less the commission, there being further credited such sums of commission as have been previously charged in the books against this account, but which, in consequence of the contracts for the sale not having been carried out, are no longer payable. This results in a total credit of £403,484, and against that sum has been charged the amount for the sale of the French patents and the amount of the shares received and standing to be received from other companies in respect of the sale of patents. These shares, together with some other shares that are held by the company, are placed on the face of the balance sheet, but without value. Although they are written off to the debit of this account, it is not necessarily the result of the writing off that the shares *are* of no value. There is further charged against this account such expenses as have been deemed by your auditors to be intimately connected with the sale or protection of patents subject to the concluding remarks made in this report. On the other side of the balance sheet, the item called property contains the lease and premises of the Millwall property, as at its cost. The buildings are held at cost, subject to 10 per cent. depreciation, written off in the course of the year. Plant, machinery, furniture, &c., have been taken at valuation, and your manager has supplied us with inventories where practicable. It seems to us that such valuations have been very carefully taken, and appear to represent good value. We have reason to believe that on 31st December, when this account was taken, that the sum under the head of property represented

good and sufficient value. The stock at the works was valued item by item and the inventory has been rendered to us. We have no reason to be otherwise than satisfied with the care taken in that valuation and inventory. The debts owing to the company and the balance receivable have been carefully gone over in the presence of the directors in the offices of the company, and we have been assured on which bills the sum is good and recoverable, and proper allowances have been made for debts, doubtful or bad. The bankers have certified to us the amounts on credit to the company, both on deposit and current account. The profit and loss account, which is a separate schedule of detailed information, is credited with sales which, together with interest and transfer fees, produce a total credit of £19,630 4s. 4d. Against this is charged, under the head of wages, materials and expenses, together with a provision for bad debts, allowances, depreciation and directors' fees, a total debit amounting to £57,898 1s. 9d. That account will be seen to result in the balance stated. But before arriving at that balance, the directors have exercised their judgment upon this account and they have agreed that the charge should be made to the debit of the patent sales account of a certain part of the expenditure charged to this debit, taking out of each individual item such part as the directors and officers believe to be immediately associated with their efforts to sell their patents; and that consideration of this expenditure has led to the transfer from the debit of the profit and loss account of the item called "Proportion of cost of installations, keeping up foreign patents, general expenses and depreciation," to the patent sales account, on the debit side of which account that item will accordingly be found, thus transferring from the cost of the working of the 12 months the sum of £18,512, and allocating it specially against the patent sales account for the year. Mr. Dever at the close of his statement expressed his readiness to give any further information that any shareholder might require.

Mr. Bettan, referring to the subsequent meeting to be called for the purpose of reducing the number of shares, said he supposed that what that really meant was that whereas a thousand shares were now worth a thousand half-crowns, say they were to be reduced to 250, which would be worth 250 half-crowns. (Laughter.)

The Chairman said that if their capital was kept up at £600,000 or £500,000, then, if say they received £400,000 for their patents, they could not distribute that £400,000 without applying to the court for leave to distribute it, and to reduce the capital over that amount, and they should have to show that they had value for the £100,000 left; but if they reduced, say, their capital to £130,000 from £400,000, the difference between these two sums could be distributed at once without applying to court. It was merely that they were doing the thing thoroughly in order that they might distribute any money coming to them without any delay. But they had better trouble their heads in the board room as little as possible as to the value of their shares. They would make a very great mistake if they tried to run up their shares by any other means than a large and profitable business.

In answer to a shareholder, the chairman further stated that they had reduced their establishment now to a very low point, and at their board meeting next day they would see how many more reductions could be made, not only at the works, but in the office in town. All expenditure they were determined should be cut down to the very lowest point compatible with keeping the business going. They would not say anything about directors' fees if the company was not earning something. None of them on the board cared two straws about that. Their object was to pull things round and try if they could go uphill instead of down, as they had been doing for the past two years.

The resolution for the adoption of the report and accounts was then put and carried unanimously.

Mr. Sellon moved the re-election of the three retiring directors. Two of the directors had offered to retire, as they had heard, but he hoped the shareholders would continue to avail themselves of their services. (Hear, hear.)

Mr. Nettlefold seconded the resolution, which was likewise carried *nem. con.*

In thanking the meeting for his re-election, the chairman alluded to the trying circumstances of the past year. If the shareholders only knew the men they had had to contend with on the Continent, they would be astonished that such men were able to carry on their plans in the light of day. He hoped that the shareholders would be kind and considerate, and support the board whenever they reasonably could, and he was sure they would pull through.

On the motion of Mr. Cawston, seconded by Mr. Delamare, the auditors (Messrs. Deloitte, Dever, and Griffith) were unanimously re-elected for the coming year.

Mr. Dever briefly expressed his thanks.

The meeting was then formed into an extraordinary general meeting for the purpose of passing two resolutions in regard to certain new arrangements as to the stock of the company.

The Chairman proposed the first resolution, as follows: That the capital of the company, which is now £800,000, divided into 400,000 shares of £2 each, of which 264,900 are in issue, and are fully paid, and 135,100 are unissued, be consolidated into 200,000 shares of £4 each, so that every shareholder of two shares of £2 each fully paid, shall become the holder of one £4 share fully paid, and that the capital shall consist of 132,450 shares of £4 each fully paid, and 67,550 shares of £4 each unissued."

Mr. Sellon seconded the resolution, which was then passed unanimously.

The Chairman moved the second resolution: "That the capital of the company be reduced from £800,000 divided into 200,000 shares of £4 each, to £200,000 divided into 200,000 shares of £1 each, and that such reduction be effected by reducing the nominal amount of every share from £4 to £1.

This resolution was also carried unanimously on being seconded by Mr. Sellon.

This being all the business before the meeting, the customary vote of thanks to the chairman terminated the proceedings.

Railway and Electric Appliances Company, Limited.

AN ordinary general meeting of the shareholders of this company was held at the Cannon Street Hotel, on Friday, the 18th inst., under the presidency of Col. R. Raynsford Jackson, who had previously addressed the following circular to the shareholders:—

"Dear Sir,—You will no doubt recollect that at a meeting of the company, held in August last, a resolution was passed sanctioning an arrangment by which the company was to be relieved of the incubus of at least 50,000 fully paid up shares. This arrangment was the result of a compromise which put a stop to litigation threatening the absorption of the company's funds, and has the following important advantages:—1st. If the business of the company continues to be carried on, £50,000 of capital, unrepresented by marketable property, will cease to share in the profits. 2nd. If the company should be wound up then the shareholders who have paid cash for their shares will be relieved of the rights formerly attaching to the holders of these 50,000 fully paid-up shares to participate in the distribution of the company's assets. This is indeed a most important consideration, for the 'fully paid-up' shareholders hold a preferential position. With 12s. 6d. paid on the ordinary shares they are entitled to receive 7s. 6d. per share before those who have paid cash for their shares receive anything. In getting rid of the 50,000 fully paid-up shares the ordinary shareholders obtain relief from a first claim on the assets of £18,750.

"My reason for addressing you is that an attempt is being made to upset this beneficial arrangement by Mr. Hugh Watt, who holds only fully paid-up shares, which have been transferred to him by the Maxim-Weston Company, and Mr. Joseph Stokes Williams, who has received 17,500 fully paid-up shares for his interest in the Williams' Company and the Williams' patents. Neither of these gentlemen have paid one farthing towards the capital of the company, and the interests they represent may be in many ways antagonistic to those of the 12s. 6d. shareholders.

"The company has never derived advantage direct or indirect in return for the 5,000 fully paid-up shares paid to the Maxim-Weston Company whose interest Mr. Watt represents, whilst Mr. Williams has the usual enthusiastic confidence of the inventor in the value of his inventions, and would think no sacrifice on the part of the *cash* shareholders too great for the development of his system. These two gentlemen ask the shareholders to set aside the present directors, and to give them seats on the board.

"Nothing could be more fatal to the interests of the company, and I urge the 12s. 6d. shareholders to appoint directors *from amongst themselves* if they desire a change in the directorate. The directors will be only too willing to give place to others if the shareholders will elect a new board capable of managing the affairs of the company. Indeed, Sir George Prescott, Colonel Elliot, and I, only intend to remain, under any circumstances, until certain definite ends are accomplished.

"The two former were desirous of retiring immediately after the meeting on the 18th inst., and refrain from doing so only because their duty to the company forbids their deserting it when surrounded with difficulty. For my part, I stand on a different footing to the other directors. At the August meeting I held, in conjunction with my friend, Mr. Lowson, the proxies of shareholders entitled to vote as owners of a considerable majority of the shares, and as a consequence I was elected, for the first time, a director on the 21st of October last year.

"I then joined the board with four specific objects in view:—1st. To assist in completing the compromise by which the 50,000 fully paid-up shares were got out of the way. 2nd. To deal with the litigation with the dissentient shareholders. 3rd. To reduce an expenditure which seemed much too heavy. 4th. To ascertain whether the Polmadie works could be made to pay, and if *not* to recommend to the shareholders a voluntary liquidation of the company.

"As regards the first of these objects, I am happy to say that I look upon it as practically accomplished, and it rests only with you to place it beyond the reach of successful attack from Messrs. Watt and Williams. With reference to the second, it is too early to say more than that the interests of the company are under the able guardianship of Mr. Burton, of the firm of Messrs. Burton, Yeats, Hart and Burton. On the third point I have to thank my co-directors, and especially Sir George Prescott and Col. Elliot, for their support of my recommendations for a reduction of expenditure. The result of the changes made has been that the salaries paid at the Polmadie Works have been reduced from £2,232 to £630 per annum, with, I venture to say, increased efficiency in the staff, whilst the loss at the works for the three last months has fallen to £530, or at the rate of £2,120 per annum, against over £6,000 per annum, the average loss during the previous eighteen months.

"The regular expenses of the London offices have dropped from £1,050 to £500, and will diminish further in June by about £200, when the lease of the offices expires. The directors also passed a resolution on the 22nd January, agreeing not to draw more than

half the remuneration fixed by the articles of association, pending the result of the dissentient shareholders' action. This arrangement was to date from May 15th, 1883.

"These reductions in the current working expenditure are in the aggregate considerable, and I call your attention to the following paragraph in the directors' report:—'Sufficient time has not yet elapsed to enable them to arrive at a conclusion as to whether the works of the company can under the altered circumstances be made to pay. If this desirable end should not be speedily attained, the directors will call the shareholders together and consult them as to the policy to be pursued.'

"I have now sketched my views, which, I believe, are those also of my colleagues. You have before you at the same time the policy of Messrs. Watt and Williams, which is to cancel the compromise arrived at with so much trouble, and either to restore the pressure upon the assets of the company, of 50,000 fully paid-up shares, or to attempt to get rid of it by a ruinous process of litigation. I confidently ask you to decide between us, and if you agree with me, to send your proxies in favour of Sir George Prescott, Col. Elliot, and myself, by return of post.

"Should you have given proxies to Messrs. Watt and Williams, I urge you to write to the secretary cancelling them forthwith.

"Yours faithfully, R. RAYNSFORD JACKSON.

"I concur in the recommendations contained in the above circular,

"GEORGE A. ELLIOT."

Mr. W. Shepherd, the Secretary, having read the notice convening the meeting,

The Chairman moved the adoption of the report and accounts for the year ending 31st December, 1883. In the report the directors regretted the unsatisfactory result shown, and stated that their expectations of a large business in electrical and railway work, for which arrangements were made, were defeated by circumstances beyond their control. The total amount of sales and contracts realised only a small sum, hence the loss had been heavy, there being a balance of £9,080 16s. 6d. to the debit of manufacturing account, besides a balance of £5,086 14s. 1d. to the debit of profit and loss account. The business of the company had been most injuriously affected by the litigation commenced by a section of the shareholders, which had not only had the effect of occupying much time, and diverting valuable service from the legitimate business of the company, but had also brought it into disfavour with the public. Colonel Jackson explained the absence of the Duke of Manchester, chairman of the company, and then said he was sorry that the report contained the announcement of a serious loss, amounting to over £14,000, but it might be some consolation to know that other companies engaged in similar undertakings had also experienced grave losses. With regard to the compromise alluded to in his circular, it would have the effect of reducing the capital of the company in that element which pressed most heavily upon its interests by 5,050 shares, so that the capital would be reduced from £170,232 to £135,822. Looking to the position of the company, as it was affected by the reduction, and taking into consideration the capital actually called up, this was the state of affairs: Whereas the capital was before £170,000, it was now £120,000, but if they took the money called up upon the shares, £57,332, and the fully paid-up shares, there remained £85,772 against £173,822, and there was, therefore, a reduction of capital entitled to claim upon the profits, if any were made, and a reduction of the principal, shareholders having a claim upon the assets in the case of liquidation. It was, therefore, enormously in the interests of the company that the compromise should be carried out. Mr. Williams had issued a series of circulars and a pamphlet, very much of which was little other than vituperation. In Mr. Williams's balance sheet, in which he tried to show the advantage of getting rid of the compromise, he proposed to obtain from the Williams Company £29,500; it would be very difficult to get that sum from a company which had no money and was in liquidation. Mr. Williams went further, and claimed as an asset, if the compromise were set aside, £22,000 to be got from the National Electric Company; that also was impossible, because the capital of the company only amounted to £8,000 or £9,000. The chairman proceeded to refute Mr. Williams's statements, and remarked that it was more than probable that the litigation which he recommended would result in failure. He then said there had been a reduction in the expenditure of the company, which Mr. Williams insinuated was caused by a stoppage of the works. They would see this was false when he told them that whereas the goods sent out from the works during the period of 18 months to December amounted to £253 per month, the amount sent out during the subsequent three months was £444 a month. The object which the directors had in view was to get rid of the incubus he had mentioned—the 5,050 shares—which, by the arrangement made, they had succeeded in transferring from being a claim on the company, to having no share whatever in its balance sheet. In addition to that they desired to so reduce the expenditure and increase the efficiency of the works as to turn the loss into a profit. Since his attention had been directed to that subject, something in the direction had been done, but they must not expect that a concern losing so heavily could turn into a profitable one all at once. His view was that they should give the works a further trial, and endeavour to make them successful, and if they could not, call the shareholders together and consult them as to their future policy.

Mr. Williams read a speech in which he asserted that by the directors' proposal property was to be squandered, and the rights and interests of the shareholders utterly disregarded. The circulars and pamphlets he had issued showed a state of affairs constituting a grave charge against some persons connected with the directorate of the company, and the statements were founded on documentary evidence of a character that seemed to be unimpeachable. He further stated that men occupying positions of trust in connection with the company as directors and otherwise were concerned in the promotion of the company, and were actually concerned in directing and forming other companies running in direct conflict with this. These he afterwards stated to be Colonel Jackson and Mr. W. A. Smith, directors. He concluded by moving that the report of the directors be received, and referred to a committee of shareholders to consider and report thereon.

Mr. Cummings seconded the amendment, and the names submitted were those of Sir George Prescott, Col. Elliot, Dr. Tristram, Q.C., Mr. Cummings, Mr. H. Watt, Mr. Burridge, and Mr. Williams.

Sir George Prescott and Col. Elliot declined to act, and

The Chairman remarked that he should treat with indignant contempt the insinuations made with regard to himself by Mr. Williams. He, however, explained his position in regard to three other companies. In reply to questions he stated that the loss per month to December had been £532, but since that it had diminished to £172.

Mr. Smith also repudiated Mr. Williams's assertions, and said that nothing that was new in that gentleman's circulars was true. Mr. Williams received, largely through his (Mr. Smith's) endeavours, £20,000 in cash and £20,000 in shares from the Scotch company; he also received money in cash and in shares from a powerful company in Belgium. He undertook to stand by the Scotch company, and help and push it through to success, but as soon as he received his £20,000 he left it in the lurch, unacquainted with his patents, to work them as best it could. He still believed that the Williams patents were the best of their kind, but that belief did not make the railway companies in Great Britain give them a trial, and was no part of the present argument. Mr. Williams was now endeavouring to overturn an arrangement which was beneficial to the company to the highest degree. In the proper time and in the proper place he was quite prepared to meet any accusation Mr. Williams might bring against him, but he was not prepared to take up their time in endeavouring to answer simply questions of entire falsification of what had taken place.

The amendment having been put to the meeting and lost, the report was carried, upon which a poll was demanded. The chairman announced that the directors held proxies representing 12,198 12s. 6d. shares and 4,050 fully paid shares, but the demand was persisted in. The chairman directed the taking of the poll at once, but eventually an arrangement was arrived at, by which the business of the meeting was proceeded with, and the poll deferred until the following day and Monday.

The Chairman moved that a special report of the directors as to the carrying into effect the terms of a compromise of litigation arrived at at the extraordinary general meeting held on the 15th August, 1883, and the deed of compromise submitted be received, and the proceedings of the directors in reference thereto approved.

Col. Elliot seconded the motion, which was carried, a poll, however, being demanded.

Col. Jackson was re-elected a director, and Mr. Worley as auditor.

At an extraordinary general meeting then held the following resolution was carried:—"That the following article be added to the articles of association of the company: 'Art. 33A. The Directors may accept from any member, on such terms and conditions as shall be agreed, a surrender of his shares or stock, or any part thereof.'"

Mr. Cummings moved a vote of thanks to the chairman, which was seconded by Admiral Sir Edward Inglefield, and carried unanimously, the meeting then terminating.

On Wednesday, an adjourned meeting was held at the offices, Lombard Street, to declare the result of the polls demanded at the meeting of the company the previous Friday. Lieutenant-Colonel G. A. Elliot presided, and stated that the number of votes for the adoption of the report was 57,917, while the number against it was 25,216, or a majority in favour of the motion of 32,701. He had, therefore, to declare that the report was adopted, that the amendment was lost, that the special report of the directors as to carrying into effect the proposed compromise (reducing the capital by £50,050 of the preference shares) was carried, and that Colonel Jackson was re-elected. The result of the poll as to the resolution for adding article 33A to the articles of association of the company was that there were 58,278 for it, showing a majority of 33,171. As, however, a special resolution required to be confirmed by three-fourths of those present in person or by proxy, he had to state that the resolution was not carried by the requisite majority, although that was practically of no consequence.

The Eastern Electric Light and Power Company, Limited.

AN adjourned extraordinary general meeting of the shareholders of this company was held at the offices, 19, Great Winchester Street, on Tuesday, Mr. Ernest Noel, M.P., presiding.

The notice convening the meeting having been read,

The Chairman said since the first meeting, that on the 5th March, was called, Mr. Bull, one of the shareholders, had

returned from India, and he was persuaded that there was a business in India, and especially in Bombay. He (the chairman) so far agreed with Mr. Bull that he had not despaired of electric lighting and thought there would eventually be a business in Bombay; but their funds were exhausted, and their attempt to get capital from the shareholders met with absolutely no response. That being the case, he, and his colleagues with him, thought it would be for the advantage of the shareholders that they should go into voluntary liquidation. Under voluntary liquidation it would be possible either to sell the Bombay installation and business as it stood for a definite sum, which, after clearing the liabilities of the company, would return something to the shareholders, or to reconstruct the company as a Bombay company, and in either case there would be some small return to the shareholders. Under the circumstances in which they found themselves, he thought they had no choice as to what they should do. If they did not go into voluntary liquidation, but went on as they were now, they might spend what remained and then find that there were amounts due which they could not meet, in which case he thought they would have been conducting the business in a manner that was not honourable, and therefore he, for one, could never take part in it, and if the shareholders did not feel inclined to go into voluntary liquidation he could only say—and he believed most of his colleagues would also—that he must offer his resignation at once, for it would not be an honourable or creditable thing for them to carry on with the possibility of some creditors getting paid in full by seizure, and other creditors, not having that resource available, getting nothing. He would therefore move "That it has been proved to the satisfaction of the company at this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and that the company be accordingly wound up voluntarily." He might add that, supposing they did not go into voluntary liquidation, in his opinion they would very soon find themselves in compulsory liquidation, which meant that any possible return would be swept away, and not one single farthing could ever reach the pockets of the shareholders.

Major Strutt seconded the motion.

Mr. Bull remarked that he had just returned from Bombay, and after going thoroughly into the company's affairs there, he found there was a very good prospect of a remunerative business, and he was prepared to move that it be carried on without liquidation, but he had just had a long discussion with the directors, and it seemed that the company was entangled with liabilities in England, and there was no help but to follow the course proposed by the chairman. He thought, however, that it should be subject to an engagement by the directors that the works at Bombay should not be imperilled, for that was the one thing they had to look to for a return of their money.

The resolution was put and carried.

The Chairman then moved the appointment of Mr. H. Cleland Heywood, the present secretary of the company, as liquidator, at a remuneration of £45 a month, for a period not exceeding six months, and intimated his intention of also moving the appointment of a committee, consisting of Messrs. Bull, Paton, Frank Wynne, Latimer Clark, and Major Strutt, to advise and assist the liquidator. He said the business of the liquidator, amongst other things, would be to have the whole of the accounts properly laid out, and he knew nobody else but Mr. Heywood who could undertake that portion of the business, except at a very large cost.

Mr. Latimer Clark seconded the resolution.

Mr. Paton suggested the appointment of a second liquidator, as it would be necessary for one to go to India, and mentioned Mr. Bull.

The Chairman said there were grave practical difficulties in the way of such an appointment, as in the case of two liquidators one could do nothing without the concurrence of the other.

Eventually, however, on the motion of Mr. Paton, seconded by Major Strutt, the names of Messrs. Bull and Latimer Clark were submitted as liquidators with Mr. Cleland Heywood, and, being put in the form of an amendment, was carried. The motion for the appointment of a committee was therefore not brought forward.

A Shareholder asked regarding the use of underground wires in India, to which

The Chairman replied that all their wires were now underground, sufficient cables of a good quality for the purpose having been sent out. This, of course, involved a much greater expenditure than if the original system had been allowed to remain in force.

Mr. Latimer Clark remarked that but for the order of the Indian Government that all wires should be placed underground, the company would now be paying its way. It had converted all their paying contracts into ruinous ones.

A vote of thanks to the chairman and the other directors terminated the meeting.

The Eastern Extension, Australasia and China Telegraph Company, Limited.

THE twenty-first ordinary general meeting of this company was held at the City Terminus Hotel, on Wednesday, Mr. John Pender in the chair.

The Secretary, Mr. F. G. Hesse, having read the notice convening the meeting, and the minutes of the previous meeting,

The Chairman, in moving the adoption of the report, which we published last week, said the gross receipts for the half-year had amounted to £231,056, against £209,131 for the corresponding period of 1882, showing an increase of £21,925. An interim dividend at the rate of 5 per cent. per annum had been paid for the past half-year, and it was proposed to distribute another at the same rate on the 24th inst., together with a bonus of 3s. per share, which would make a total distribution of 7 per cent. for the year 1883, against 6¼ per cent. for 1882, when the share capital was half a million less than now. They would observe that in fulfilment of their promise at the last meeting, they had carried a very considerable amount to the reserve fund. The policy the directors had adopted of paying a 5 per cent. dividend, and dealing with all over 5 per cent. by way of bonus, would, he thought, be satisfactory to the shareholders. Every year gave them greater confidence in the class of property with which they were dealing, and he believed that when the cycle of good trade came—and he believed it certainly would come—no institution would derive greater benefit from it than the telegraph systems of the world. When last addressing them he referred to negociations then going on with France. The bargain was made; they got £10,600 per annum from the French Government for 20 years, and the line was now working successfully. The Minister of Marine and the Colonial Secretary had expressed to him their satisfaction at the manner in which the work had been carried out, and in which it was now being conducted, for they now got messages in the course of a couple of hours which took almost months to reach them before the telegraph system was inaugurated. The cable from Saigon to Tonquin they were also utilising as an alternative cable betwixt Saigon and Hong-Kong. They would eventually require another cable from Singapore to Saigon, and in that way would duplicate their system. Now commerce was depending so much upon telegraphs, and so many of the important operations of the country were conducted by telegraph instead of by letter—letters only now being used for registering transactions—it was impossible to continue any system of telegraph traffic, and to secure the confidence of the mercantile community, unless the system was duplicated. They had duplicated so far without adding to their capital, and he hoped they would, with a very moderate increase, duplicate their whole system and maintain their dividends. A convention had been entered into with the Portuguese Government to connect Macao with the company's system at Hong-Kong. This had been talked of for the last 20 years, but the war in China had induced the company to communicate with the Portuguese Government, and within the last three or four months they had secured a concession and a guarantee of £500 per annum for ten years. The cable for this purpose would be taken from the store at Singapore. There was some trouble with the Chinese in regard to the Hong-Kong and Canton line when he last addressed them; but, although they were a peculiar people, the Chinese generally conformed to what was shown clearly to be to their advantage; and now that the system was opened and working satisfactorily, their relations were becoming more friendly every day. A question which interested them a little was the making of a government line from Bangkok to Tavoy, which might create some competition; but the line had only been opened two months and had broken down three or four times, and it was now closed for a time in consequence of the rate of mortality amongst the staff. The Sunda Straits cable, which was destroyed by the earthquake, had been replaced, and was now in good working condition. In regard to their cables generally, they were all in satisfactory working order. Their repairing ships had been steadily employed; but, their lines being duplexed, no loss of traffic had resulted. A great deal of the cable that was exposed to the teredo had been taken up and had been replaced to the extent of nearly 800 miles by brass-ribboned cable, and they found that they had at last really beaten the teredo. During the year, 1,685 knots of cable had been added to their system, 894 knots being brass-ribboned, and they had now a total length of 12,100 knots of cable. He thought he might say without hesitation that they had a property they could control, and he would for the first time say that submarine telegraphy was now a sound and safe property. He moved the adoption of the report, and the declaration of a dividend of 2s. 6d. per share and a bonus of 3s. per share, both free of income tax, payable on the 24th inst.

The Marquis of Tweeddale seconded, and the motion was carried.

Sir James Anderson and Mr. F. A. Bevan were re-elected directors, and the auditors, Mr. Henry Dever and Messrs. Quilter, Ball & Co., reappointed, after which, with a vote of thanks to the chairman and the directors, the meeting terminated.

Brazilian Submarine Telegraph Company, Limited.

THE twenty-first ordinary general meeting of this company was held at the Cannon Street Hotel, on Wednesday, Sir James Anderson presiding in the absence, through illness, of the chairman, Viscount Monck. We published the directors report in our last issue.

Mr. Richard Collett, the secretary, having read the notice convening the meeting, and the minutes of the previous meeting,

The Chairman said the principal item in the report was one which, perhaps, they must regret, for they had to record a loss of £37,000 in revenue for the last half year, mainly owing to 74 days' interruption of the cable from St. Vincent to Pernambuco; £6,000 however, was owing to opposition, in a very small degree, on the West Coast route, and in a larger degree in consequence of a reduction of tariff. As to the loss from the interruption of the line, he thought he could very honestly congratulate the share-

holders upon the result of that large repair. In 74 days that cable was repaired in very deep water, and at a part of the ocean where there was every reason to apprehend considerable difficulties, both from currents and unknown depths. For his own part, he looked on these repairs, made by the Telegraph Construction Company and their experienced staff, with unfeigned admiration. One thing he was quite certain of, from the experience of the last 17 years, that they always would have interruptions to cables; wherever there was uneven ground, the cables, in time, would break, and there had never been a repair effected yet until they managed to get the cables from the rough ground and found a smoother bottom. Therefore they never knew quite how much cable they would require before they could get round the bottom of the ocean where it was rocky or uneven. It must be satisfactory to all to know that when the cable was recovered, notwithstanding that it had been immersed for ten years, it was in thoroughly good condition. To his mind this was one of the most satisfactory evidences of the value of their property. Of course it was impossible, so far as modern science had taught, to sound the ocean so thoroughly as to know how to lay a cable entirely on a smooth bottom. He himself had known an inequality of two miles in depth in half a mile in distance, and sound as they would they could not easily avoid such inequalities as that. Only that morning, the captain of one of their ships told him that in going to repair a cable that was well established, where he had expected to find a depth of only 45 fathoms, he found 300; another said where he had about 80 or 90 fathoms under the bow of his ship, he had 260 under the stern. There must be expensive repairs where such a state of things existed; but fortunately in this company they had had a long immunity from repairs and accidents, and this had enabled them to amass a very substantial reserve fund, with which, and an amount to be raised by debentures of about £150,000 or £200,000, they would be able to pay for an entirely new cable, and also £28,000 for the last repairs. They might congratulate themselves that in ten years they had duplicated their system without increasing their capital, except by a very small amount. With the duplicate cable they could fairly look forward to avoiding such a loss of revenue as he began by referring to, and they were, therefore, in an altogether better position. He understood also that their neighbours, the Western Brazilian Company, were about to lay a very large section of new cable in the parts of their system most liable to interruption, and he thought they were justified in assuming that with their system duplicated, and the Western Brazilian Company's cable out in first class order, they would avoid interruptions, and might fairly anticipate being enabled to pay off their debentures, lay by a fair reserve, and continue to pay a fair dividend of 5 or 6 per cent. He concluded by moving the adoption of the report and accounts.

Mr. Weaver asked what was the nature of the competition they had to deal with.

The Chairman explained that it was in consequence of the lowering of the tariff on the West Coast route, in the endeavour to get the traffic for the River Plate round by Panama, Peru, and Galveston; there was no new competition anticipated, but this had arisen within the last twelve months.

Sir Thomas Fairbairn seconded the adoption of the report, which was carried, the meeting thereupon terminating.

Telephone Company of Ireland, Limited.

THE third half-yearly meeting of the proprietors of this company was held at the offices, Commercial Buildings, Dublin, on Wednesday of last week, Mr. E. D. Gray, M.P., occupying the chair.

The Chairman, in moving the adoption of the report and accounts, said the number of their exchange subscribers had extended from 411 to 507, and the number of the renters of private lines had increased from 127 to 141, showing that the business of the company was regularly and steadily prospering. They had had considerable difficulties to contend with, the Post Office claiming to have an absolute control over their business. They had, however, succeeded, after lengthened negociation, in obtaining an extension of the area conferred by their present license from four to five miles radius, a very large increase. The attitude of the Post Office towards telephone companies was a subject which would have to be brought before Parliament very soon; the department had thrown every obstacle in the way of the development of telephone business, and had shown a most unreasonable and childish jealousy towards telephone companies. The latest instance of this was the extra radial extension which their company had obtained to give the inhabitants of Kingstown the facilities enjoyed by the inhabitants of Dublin. After negociations, extending over months, they induced the Post Office to give them this concession, but they gave it on the terms of charging them 12½ per cent. for that district in place of the 10 per cent. they charged before. The Post Office would not grant new licenses unless on the condition of the company agreeing to sell to them instruments which they did not own, and over which they had no control further than the right to obtain the use of them from the parent company. He was told that in England they sought to compel the companies to charge a minimum rate to their subscribers, imagining perhaps that they were doing it in the interest of the public; but it was directly against the interests of the public, because it was throwing impediments in the way of the public obtaining the advantages they would otherwise enjoy. Their accounts showed that in spite of these disadvantages their business was progressing satisfactorily. He had no hesitation in saying that he believed their shares to-day were worth 50 per cent. at least more than they paid for them 18 months ago. If the board thought it desirable to endeavour to induce other telephone companies in England to take some public action to compel the Post Office department to show its hand in its favour and take up some comprehensible and reasonable position with reference to telephone development, he trusted they would have the support of the shareholders. He must say that his experience of public departments showed him that very little was to be got out of them by private negociations, and that it was only by bringing them to book in public that any satisfaction could be got from them.

Mr. Winstanley seconded the motion, which was carried, and subsequently dividends at the rate of 6 per cent. on the unconverted 6 per cent. preference shares; of 5 per cent. on the 6 per cent. preference shares converted into 5 per cent. preference shares; and at the rate of one-half per cent. on the ordinary shares of the company, were declared. The retiring directors were re-elected, and a sum of £200 voted to them for their services during the past 11 months.

Montevidean and Brazilian Telegraph Company, Limited.

AN ordinary general meeting of this company was held at the offices, 2, Tokenhouse Buildings, on Monday, Sir Thomas Gore Browne, K.C.M.G., C.B., in the chair.

Mr. Fraser having read the notice convening the meeting,

The Chairman moved the adoption of the accounts and the following report:—

"The company's percentage of the gross earnings of the Western and Brazilian Company amounts for the year to £2,240 12s. 7d.—a reduction of £529 5s. 8d. as compared with the preceding year. This serious diminution in the company's income arises from a lengthy interruption of cable communication, lasting from 22nd September to 4th December, 1883. The directors regret to inform the shareholders that another interruption occurred early this year, which, though not of great duration, will still cause considerable loss to the company.

"After setting aside £500 for redemption of debentures, and providing for all charges and debenture interest accruing during the year, there remains a net balance of £457 12s. 6d., out of which it is proposed to pay a dividend of 1s. per share (10s. per cent.), and carry forward a balance of £41 18s. 6d. to next account."

Mr. Charles Cameron, M.P., a director, seconded, remarking that the company was entirely dependent upon the earnings of the Western Brazilian Company, a percentage on which they received under an agreement many years old. In addition to the causes of diminution in the receipts of the company stated in the report, the Brazilian Government had erected land lines in opposition, which necessitated a reduction in the tariff.

The report having been carried, a dividend of 10s. per cent. was declared payable on the 15th of May next.

Sir Thomas Gore Browne, the retiring director, was re-elected, as also was Mr. W. S. Ogle, the auditor, the meeting then terminating with a vote of thanks to the chairman.

Reuter's Telegram Company, Limited.

ADMIRAL SIR JOHN HAY, Bart., M.P., presided, on Wednesday, at the 20th ordinary meeting, at the offices of the company, 24, Old Jewry.

The Secretary having read the notice convening the meeting,

The Chairman said: Following the ordinary course, the report and accounts will be taken as read. I will now proceed to move the adoption of these. I have nothing to say with regard to the report, which speaks for itself. With regard to the balance sheet I should like to make one or two observations. You will observe that under the head "sundry creditors," it would show a decrease of £5,657. This is owing to £3,500, a loan from the bank, having been paid off, and a smaller sum due to the telegraph companies at the end of 1883, as compared with 1882. On the other side of the account, "sundry debtors," I should like to give you this information. This account has diminished by nearly £2,000, and the explanation of that is that the balances in the hands of agents and other persons have diminished to that extent. The reserve fund is increased to £8,049, by the usual addition of the rental of 24, Old Jewry, but will be further augmented to £10,000, as explained in the report. In the profit and loss account current expenses, you see there is hardly any variation. Telegrams and agencies have decreased nearly £7,000, and about £5,000 of that is owing chiefly to the cessation of the very exceptional expenditure during the Egyptian war of 1882; and £2,000 was partly owing to a changed form in keeping certain accounts. With regard to the reserve fund, our reason for increasing it is to meet circumstances of exceptional expenditure. There are no special claims upon it; the company's affairs were prospering, although lately Egyptian affairs have again entailed some heavy expense.

Baron de Reuter seconded the motion for the adoption of report and accounts, which was carried.

Mr. J. S. Stopford (one of the board) proposed the re-election of the chairman of the board, Col. James Holland, who was away from that meeting indisposed, for the first time for about 20 years.

Baron de Reuter seconded this motion also, which was carried, and Messrs. Quilter, Ball, Crosbie, Glegg and Welton having been re-elected auditors, the proceedings terminated with a vote of thanks to the chairman, proposed by Mr. Loveday.

The Oriental Telephone Company, Limited.

THE report of the directors for the year ending December 31, 1883, states that at the date of last report the total number of exchange and private line subscribers using the company's wires, including those in the Hawaiian Islands (numbering 272), was in all 1,098. The shares in the Hawaiian Bell Telephone Company were sold in November, 1883. The company is therefore no longer interested in business in the Hawaiian Islands. According to latest advices from the various stations, the total number now stands at 1,279, notwithstanding the withdrawals in the Sandwich Islands, so there has been a large increase in subscribers during the year, equal to about 55 per cent. The revenue from actual working of exchanges credited to the year 1883 has not, however, proportionately increased, because it has been requisite at various stations, by the advice of the local agents of the company, to reduce the tariff in the hope of better ultimate results. The International Indemnity Commission, which has recently completed its sitting in Alexandria, has made an award of 200,000fr. on account of the losses sustained during the riots in Alexandria in the year 1882. This award is made to the Oriental Company. The directors recommend a distribution at the rate of 5 per cent. per annum, free of income tax, for the year 1883 on the ordinary shares of the company. This will absorb the sum of £5,649 10s., and leave a balance of £27 1s. 8d. to be carried forward to profit and loss account for 1884.

Phosphor Bronze Company, Limited.—This company notifies a reduction of prices for its phosphor bronze alloys, various descriptions being offered at from £110 to £133 per ton.

Provincial Telephone Company, Limited.—Creditors are required to send their claims to Mr. W. B. Campbell, of 11, Queen Victoria Street, E.C., the liquidator, by the 2nd of May next.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th April are £3,122 as compared with £4,069 in the corresponding period of 1883. The January receipts, estimated at £5,374, realised £5,436.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

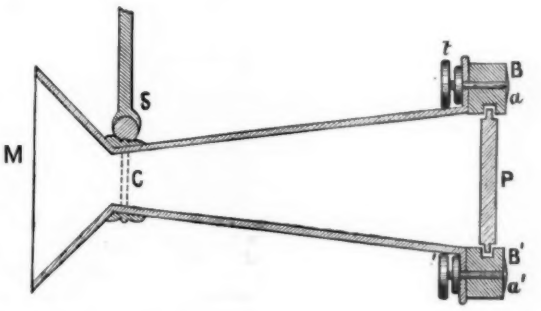
3917. "Galvanic batteries." H. J. ALLISON. (Communicated from abroad by A. Haid, of America.) Dated August 13. 2d. Relates to galvanic batteries, and its objects are mainly to obtain a battery which combines with a capacity for producing a high electromotive force, great constancy, and small size, and to make the battery more portable. The negative electrode is contained in a porous cup or jar of any ordinary character and consists of a carbon conductor, surrounded by and embedded in a mixture of carbon and a depolarising substance insoluble in the liquid of the battery, in a solid and compact mass. (*Provisional only.*)

3934. "Dynamo-electric machines. W. P. THOMPSON. (A communication from R. J. Sheehy, of America.) Dated August 14th. 8d. The main object of this invention is to construct an electric generator of the dynamo type, which shall, as far as practicable, produce a constant electric current of any required strength with the least possible expenditure of motive power, and this is accomplished by causing two or more armatures of improved construction, to be respectively revolved through fields of force of constant, but opposite, polarity, in which armatures two series of electric impulses are simultaneously induced, the phrases of which are so related, that when combined, the resultant is a current of approximately uniform strength.

3963. "Appliances for working telephones." F. MORRIS. Dated August 15. 2d. Consists essentially in causing the vibrations or sounds arising from the transmission of telephonic messages, to take place in enclosed cylinders containing air or gas of greater density and pressure than that of the ordinary atmosphere; and such increased density is obtained by using dense gases or compressed air for the purpose. (*Provisional only.*)

3970. "Construction of lead plates for the storage of electro-chemical force in accumulators." A. C. HENDERSON. (Communicated from abroad by G. Philippart, of France.) Dated August 16. 2d. The plates are exclusively composed of refined soft lead, made into thin plates, sheets, rods, wires, and so forth, by lamination, beating, fusion, or by any other mechanical means: being afterwards mechanically united in blocks. These united blocks are then compressed in an hydraulic press, or other convenient method, so as to form a compact and apparently homogeneous whole. The compressed blocks are then sawed, or are preferably cut into plates of all thicknesses, which then serve as positive and negative electrodes in accumulators. (*Provisional only.*)

4003. "Telephonic apparatus." G. H. B. A. E. SLATER, and F. T. HOLLINS. Dated Aug. 17. 6d. This invention has for its object the greater simplification of apparatus described in Letters Patent, March 10th, 1883, No. 1290. The figure is a vertical cross section of one form of transmitter of a "speaking trumpet" shape, and which may be made of wood, ebonite, or any other suitable material. M is the mouthpiece, P the pencil contacts (preferably of carbon), B, B', the blocks in which the pencils rest,



t, t', the terminals by means of which the wires are attached to the blocks, B, B', the screws, a, a', holding the said blocks in position, or other device may be used for this purpose. Although only one pencil is shown we may advantageously use two or more, and these are of course in practice inserted in the primary circuit of an induction coil as will be understood. C is the collar fastened round the neck of the trumpet, and by means of which it is shown fixed to a small stand or pillar, so that it may be adjusted to any angle desired by the speaker, or it may be placed permanently in position.

4028. "Apparatus used for covering wire with plastic material, &c." E. T. TRUMAN. Dated August 20. 4d. Has reference to apparatus for covering wire for telegraphic or other purposes with gutta percha, or other like plastic material, in which the wire to be covered is caused to pass through a chamber or nozzle supplied with plastic material, by means of a suitable forcing or filling machine. The objects of the improvements are, first, to prevent excess of, or superabundant pressure upon, the plastic material; and, secondly, to provide efficient means to fix or regulate the amount of material supplied to the covering portion of the machine.

4038. "Cells of voltaic batteries." R. H. COURTENAY. Dated August 21. 2d. Consists first in the construction of negative elements with large surfaces in the usual space of porous cells. To effect this, the inventor carbonises a suitable fabric of any fibrous substance or substances which can be readily carbonised, such as cotton cloth, wadding or canvas, after having previously saturated it with a mixture of plumbago, moistened with water and saccharine matter, or other suitable liquid, and dried. The second part of the invention consists in compounding an oxide or compound oxides, with pounded dates or other fruit of a saccharine nature, or sugar itself may be used, the object being to render the compound when carbonised of a spongy nature so as to obtain large surface; the cakes compounded as above described are carbonised and broken in pieces, and placed in the voltaic cells with the carbon elements. (*Provisional only.*)

4059. "Galvanic batteries." G. C. V. HOLMES, and S. H. EMMENS. Dated August 21. 6d. The inventors take a preferably rectangular outer cell of waterproofed wood, stoneware, or other suitable material, and one or more inner cells of porous material, and suspend or fix it in the outer cell, by means of caps hermetically attached, placing a plate of zinc or other metal on each side of each cap, and holding the same in position by key pieces, which at the same time cover in the outer cell. Through the cap of the porous cell is carried a charging tube and vent-hole, both of which can be closed at pleasure. The branch tube in the caps of the porous cells are connected when desired with a discharge pipe, or with a gas-bag, gasometer, or apparatus for the conversion of such fumes into chemical products. The dehydrogenising mixture employed in the battery is obtained by the treatment of any metallic nitrate or nitrite by a dilute solution of sulphuric acid.

4061. "Manufacture of commercial products resulting from the operation of galvanic batteries." G. C. V. HOLMES and S. H. EMMENS. Dated August 21. 4d. First, in dealing with the nitrogenous fumes, the inventors conduct them into an atmosphere of ammonia and air, where they become oxidised, and then form nitrite and nitrate of ammonia, which may be collected as a powder, or caught in water and crystallised. The inventors provide the requisite supply of oxygen either by admitting fresh air from time to time, or by passing in fresh quantities of oxygen from any suitable source, or by electrolysing the water in the receiving chamber, and thus causing nascent oxygen to enter the atmosphere. Alternatively, they absorb the fumes by causing them to pass into a solution of any basic substance or ferrous sulphate, and thus form solutions of nitrates and nitrites for use in chemical operations. Secondly, in dealing with the spent fluid from the negative cells of the batteries specified in the application for letters patent bearing even date herewith, the inventors allow the same to settle in any suitable vessel, and then decant or draw off seven-eights of its bulk, and thereby form an effective deodorising and disinfecting fluid; or alternatively, they mix the fluid with bones, phosphate of lime, blood, or animal refuse, and thus form valuable chemical manures. Thirdly, in dealing with the

solutions of zinc from the positive compartments of galvanic cells, they employ it as a solvent for scrap zinc, and when saturated with zinc they either use it as an electrolyte for the preparation of oxidised lead plates for secondary batteries, or for zinc-plating, or both, or they precipitate the zinc by adding basic sulphide, basic hydrate, or lime, and then collect the precipitate for use as a pigment, or as a material for the manufacture of zinc salts, and other chemical products.

CORRESPONDENCE.

Electric Lighting.

We are now in the depths of depression in all that appertains to lighting by the "new method." To some extent this was to be expected, after the mad rush made two years ago, after all phases in *any* electric light company; the Stock Exchange, as they are too ready to do, lending all and every assistance to the gambling schemes, no discrimination being used as to nature or value of the security offered! Like the "Indian Gold Mines," the electric light bubble arose, the former glittered for a brief period, and faded away, the latter went up like a rocket, and has come down like its stick!

But, may I ask, have not the "Board of Trade" been much to blame for their action, and the rules adopted, and put in practice; the wishes and recommendations of vestries and boards have been by them entirely ignored, and systems of electric lighting entirely unsuited to parishes or districts, "compulsorily" forced upon them. What has been the consequence? annoyance and chagrin to the "local authorities," enormous expense, and failure to some light companies, and for a time the all but stoppage of progress by the "new method." *When* this check is to be counter-balanced it is difficult to say, some companies who have endeavoured to carry on business on terms too reasonable, have been ruined; others, led by managers and directors knowing nothing, have come to a standstill; while even the most fortunate, sadly weighted by enormous payments, to "vendors" for "patents" of no value, can hardly hope to carry on business at any profit to their shareholders. *If* money could be forthcoming to replenish the low or exhausted exchequer, the little experience gained *might* be supposed to teach something, but I fear the public are sick even unto death with all that to electric light pertains, and I see little chance of a revival for some time to come of any demand for a description of "stock" which has been so much, and to some extent rightly, depressed!

Such being the position, what is the best course to adopt? *That*, lighting by electricity, now fairly on the rails, will, nay *must* proceed, there can be no doubt; to obviate as much as possible the *entire* loss of the large sums subscribed by the public, should then be the aim of all interested in lighting by the "new method."

An amalgamation of directors or all really good systems might answer, but then there comes the jealousies to be got over, the rivalries of the various electricians and managers, real or spurious, and which would certainly delay *what* is most desirable, a quiet and radical change for the better.

Again, and what would, I think, be best for the general public, though perhaps on many misguided shareholders inflicting heavy losses. *Let* electric light companies confine themselves to the manufacture of what they possess a patent for; their "capital" being reduced to what is requisite alone for such operations, of course there would be the dismissal of guinea-pig directors, "would-be electricians," and establishments, in most cases existing, far beyond what prudence, or even necessity, required. The manufacture, under proper scientific guidance, would then be carried on of dynamos, special lamps, candles, globelets, or any article, small or great, for which the company had an undoubted and *undisputed* right. Why, may I remark, should so-called electric light companies attempt to do what can be done better, less expensively, and more expeditiously by others, as for instance the laying of wires and cables, making of lamps and globelets, &c.

In former letters I have expressed an opinion that there is hardly an electric light patent worth anything. Take the one at present only within the reach of the rich, viz., the "incandescent lamp," there are of these many, no one really much better than another, save that some of the *best* are the cheapest, though not bearing well known names.

Of "Regulator" lamps we have a score, or near that amount. What patent in such can there be? A lateral movement in one, perpendicular works in another! More clockwork, less clutch, all more or less the same. Some of them, and where constant looking after matters little, admirable, but no patent to justify prices paid, and "royalties" asked. If there be a patent at all it is in the "candle" invented by the Russian engineer; and which, whatever be its faults, took a new line, dispensing with mechanism in the lamp, and first rendering lighting by the "new method" a practical business operation. From the above remarks, I desire to show that there is really little *patent* in any known system, nothing certainly to justify the conduct and procedure of electric light companies in the past. One large company, with a mechanical lamp, to which belonged no real patent, and a dynamo copied from another, and at the time the subject of a "law trial," brings out a "subsiduary," selling to its unfortunate child its valueless rights for a quarter of a million! The rights of a Northern chemist, in another case, are purchased by a "company" for a similar amount. What rights? To insert in a globelet a filament of particular construction? Nearly half a million, one half in cash, was received by the vendors in the two cases cited. Can any amount of business pay for such?

In conclusion, let vestries, public bodies, manufacturers, shopkeepers, and private individuals, consult before adopting the electric light, "electricians" (in the right meaning of the expression), as they doubtless would an architect regarding the building of a house. The purpose the light is required for, will, no doubt, decide the system most suitable. "Contractors" able and willing to carry out the necessary work will be forthcoming; as waits a builder on the "designer" of an edifice. And, as before said, let the holders of real "electric light systems," confine themselves to the legitimate sale of what they possess.

Electron.

Kensington, *April*, 1884.

The Efficiency of Secondary Generators.

You publish in your paper of the 19th instant, an extract from M. Hospitalier's critique in the last issue of *L'Electricien*, on Doctor Hopkinson's official report upon the Gaulard-Gibbs Secondary Generators, and I hand you herewith a translation of M. Gaulard's reply to M. Hospitalier, which will, no doubt, be interesting to your readers.

J. E. Pickering.

18, Warwick Street, Regent Street, W.,
April 21*st*, 1884.

[TRANSLATION.]

Sir,—In *L'Electricien* of the 15th instant, you publish the report of Dr. Hopkinson *in extenso*, following it up with a long discussion upon some of the figures which are given therein; but you have omitted to refer to the second part of the report which establishes indisputably the return of our apparatus at 86 per cent.

It does not devolve upon me to defend the figures and deductions of Dr. Hopkinson, and I should not have asked you to insert this letter of rectification, had you not in your remarks attacked the system of distribution itself, in affirming that with the means known up to the present time it was impossible* to obtain the same results more economically.

Keeping to the same conditions as those in which we are placed, we will endeavour to arrive at the cost

* [This word should doubtless be "possible."—EDS. ELEC. REV.]

of the conductors which must be employed by Mr. Edison, with whom you compare us, for feeding in derivation 151 incandescent lamps, over a circuit, 25 kilometres in length, and allowing a loss of 36 per cent. of initial work we find: that 151 lamps of 60 Watts absorb 9,060 Watts, to which must be added 36 per cent. or 3,261 Watts, this gives a total of 12,321 Watts, which must be produced by means of an electric current of 123 amperès, and an electromotive force of about 100 Volts.

It follows from these figures that, to limit the loss by the conductor to 3,261 Watts, representing the loss allowed of 36 per cent, the said conductor should have a resistance of $\frac{3261}{123^2} = \frac{3261}{15129} = 0{\cdot}215$ ohm, and which could only be obtained by means of a conductor of 0,002325* square millimetres, weighing consequently 465,000 kilos. (over 458 tons), and costing at least 1,250,000 francs (£50,000!)

The cable which we are at present employing cost us 2,500 francs (£1,000.)

It is unnecessary to calculate the price of a cable which under the same conditions would be employed by the Direct System to supply 500 lamps, the figures just given amply sufficing to show which side can claim the greatest economy in the transport to a distance.

(Signed) L. GAULARD,
Chief Engineer.

The Theory of Dynamo-Electric Machines.

The method of studying electro-magnetic induction by means of line of force diagrams, although such an elegant one, is not universally used as it should be. Many scientists adopting a method of description, dividing induction into numerous different kinds or types, such as "the direction of the magnet upon the wire," "the action of the iron core upon the wire coils," &c., &c., and usually mixing these up with lines of force in a manner which is most mystifying. I, for my part, am unable to perceive the beauties of this method, which, at least, when studying the modern continuous current generators, introduces much unnecessary complication. Dr. St. Doubrava* has conclusively shown that the continuous current dynamos of Siemens and Gramme should be regarded in the same light as the Faraday disc generator. This subject was treated from a similar point of view by Mr. H. Cunynghame in an article published in the ELECTRICAL REVIEW, and taken from his work, "The Law of Electric Lighting." This article was criticised by the late Comte Th. Du Moncel in *La Lumière Electrique*, M. Du Moncel not being an admirer of this method of explanation. As will be remembered, Mr. Cunynghame replied most ably in the ELECTRICAL REVIEW to the objections of the Comte Du Moncel. Maintaining that "it is not enough to treat a helix as sliding on a magnetised bar or core of any particular form, we ought also to know the strength and direction of the magnetic forces radiating from the magnetised bar," with which statement I quite concur, having long been of the opinion that line of force diagrams furnish the most graphic, and at the same time the most accurate and elegant method of demonstrating the action of dynamo-electric machines, while there is not a single generator whose action cannot be described in this way. It will be remembered that some time back there appeared in the ELECTRICAL REVIEW a series of diagrams representing the distribution of the lines of force in the armatures to two types of Gramme machine, namely, the ordinary bipolar inductor, and the unipolar inductor, or Ball dynamo. In the present communication I will endeavour to describe the action of two types of multipolar Gramme generator:

Fig. 1 illustrates the action of a Gramme armature influenced by four field magnet poles, alternating circumferentially around the ring. Four poles, diametrically similar, are therefore induced in the annular core. Between these poles lines of force flow across the space in the interior of the ring. These lines are cut by the wires forming the internal halves of the convolutions. The lines, *a*, *a*, and *b*, *b*, represent the "diametres of commutation." Such a method of construction neces-

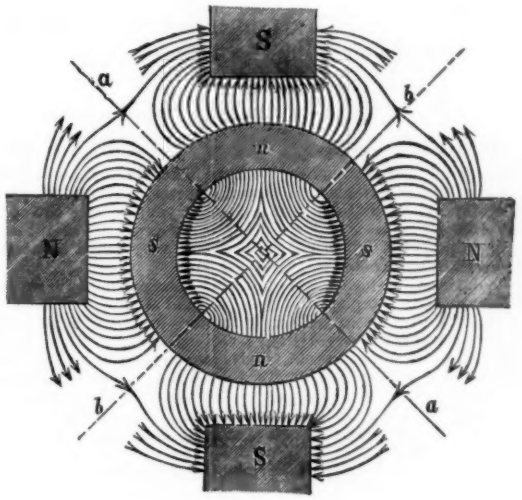


FIG. 1.

sitates the use of four commutator brushes, that is, unless the sections are internally cross connected.

Fig. 2 represents the machine of Mr. R. Kennedy, which has been erroneously called "a true unipolar dynamo." It is, as will be seen, precisely similar in its action to the multipolar Gramme machine shown in Fig. 1, the only difference being that the lines of force emanating from the two diametrically opposite induced poles, *n'* and *n*, radiate into space instead of entering

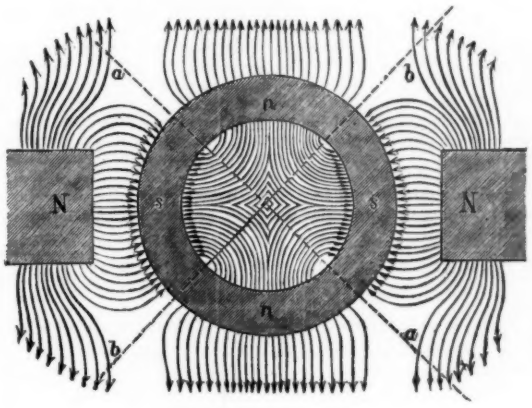


FIG. 2.

two south field magnet poles as in fig. 1. The internal distribution of the lines of force is the same as in the four pole Gramme. It likewise requires four commutator brushes. This is another instance of the misuse of the term, "unipolar," which should only be applied to machines like those of Ferraris, Siemens, &c., which have no commutator, and produce continuous currents, there being no change in the direction of the lines of force cut.

I will, perhaps next week, with the permission of our editors, describe the action of some other types of dynamo electric generator.

To conclude, I must remark that as I write purely in the interest of scientific truth, I will be pleased to discuss this subject with anyone meeting me in a scientific spirit, but I shall take no notice of correspondents indulging in personalities.

F. De Wolffers.

* Written thus in the manuscript.—EDS. ELEC. REV.

* ELECTRICAL REVIEW, page 77, August 4, 1883.

The Heinrichs' Dynamo.

I beg to enclose you a copy of the report and a table of tests, taken by Messrs. Alabaster, Gatehouse & Co., of my dynamo-electric machine. I shall esteem it a great favour if you will give it a space in your valuable journal.

Charles F. Heinrichs.

52, Woburn Place, Russell Square,
April 12*th*, 1884.

22, Paternoster Row,
London, E.C.,
April 5*th*, 1884.

Charles Heinrichs, Esq.

Dear Sir,—At your request we have made an extended series of tests on your series wound dynamo-electric machine, which we understand is the first one constructed by you, as long ago as the year 1881-82. These experiments were carried on at intervals during a period of five weeks or so, and a very large number of observations were made.

We desire to preface our results with a few preliminary remarks on the apparatus employed by us. We had at our command, for the sake of comparisons, three voltmeters and one ampèremeter of the Ayrton and Perry design, a voltmeter devised by Captain Cardew, and two Siemens electro-dynamometers. Two Wheatstone Bridges by different makers were used for checking resistance measurements, and several mechanical speed indicators, checked by Kempe and Fergusson's electrical indicator, enabled us to take accurate observations of speed. After a large number of preliminary tests we selected for our readings of electromotive force and current, an Ayrton and Perry voltmeter* (which was several times compared during the course of the experiments with a Standard electromotive force of known value) and a Siemens electro-dynamometer. The resistance of the circuit, the external portion of which was made up of a number of coils of thick copper wire, cotton covered, was measured after every experiment. Calculations of the electromotive force from the current and resistance, or current from electromotive force and resistance, invariably very closely corresponded with the results indicated by the readings on the respective instruments, thus assuring us that our electrical instruments could be well depended upon. For horse-power measurements we employed a Morin dynamometer and a Prony brake.

The Morin dynamometer was fixed so that it drove the dynamo machine. This arrangement was adopted to avoid any errors which might be occasioned by the varying friction of intermediate countershafts, slipping of belts, &c. We were forced, however, to abandon any calculations of horse-power from this dynamometer, since the centrifugal force of the moving parts of the instrument appeared to interfere very seriously with the results when the speed was comparatively high.

The constant given for the dynamometer is also evidently erroneous for varying speeds, so we were compelled to have recourse to the Prony brake, using the Morin apparatus merely as an indicator. Thus, the Morin indicated a certain pull when the dynamo was running at a given speed, and producing, say five electrical horse-power. The same pull at the same speed would then be *reproduced* by applying the Prony brake to the dynamo, and the horse-power *absorbed* by the dynamo could then readily be ascertained. A large number of tests were taken in this manner, which appears to us to be a most satisfactory method, indeed, the only one to produce accurate results. We may add that the Morin dynamometer calculations agreed fairly well with those taken from the Prony brake when the speed did not exceed 1,000 or 1,100, revolutions. With the latter apparatus, however, we dispense entirley with springs, irregularities from centrifugal force, loss in transmission by belting, &c. We append a table of several of the tests which were many times repeated.

The construction of the Heinrichs machine, which is simple and strong, appears to be particularly well adapted to secure a minimum loss from heating effects, the influence of the so-called Foucault currents, &c. When arc lamps were employed as the external resistance, we made use of either a number of straight carbon lamps or a single circular carbon lamp of the Heinrich's type, with the addition of wire resistance. Although no photometric measurements were made, we cannot but think that the Heinrich's lamp should stand foremost amongst those now in general use, as from its peculiar construction the whole of the luminous rays are thrown downwards. All readings were taken at as nearly as possible the same instant, this being rendered necessary by some considerable irregularity of engine speed. The observers at all the instruments were frequently changed about in order to ensure every possible means of reducing error.

We are, dear Sir,
Faithfully yours,
H. ALABASTER, GATEHOUSE & Co.

OBSERVATIONS.—The resistance of the dynamo depended of course upon the amount of current produced, and upon the time the machine had been kept running. According to our views the commercial efficiency of the machine should be calculated with the horse-power for the machine running empty included. The commercial percentages would then be less (see column 4); but in recently-made tests of well known machines, this extra H.P. has not been taken into account, but, as will be seen, we have given both calculations. The formula for the brake is $\frac{n \times L \times s}{5252}$ where n is the number of revolutions per minute, L the length of the lever in feet, and s the weight inclusive of the lever and scale. Where a wire resistance formed the external circuit, we have given the current and total measured resistance; when lamps were employed we give the E.M.F. and current, the external resistance of course being calculated. We may add that the machine did not on any occasion show any noticeable sparking, and the peculiar construction of the armature and pole-pieces appears admirably adapted for securing the highest degree of ventilation. The mean diameter of the Heinrichs armature is 8½ inches, the periphery speed therefore may be easily calculated. The weight of wire (No. 16 B.W.G.) in the armature is stated to be 16½ lbs. and on the field magnets (No. 10 B.W.G.) about 80 lbs. The above tests were repeated so often that we are convinced they might be readily reproduced at any time. On the 10th of March the following test was made: Nine straight carbon lamps were arranged in three parallels of three each, the current flowing was 33 ampères, the machine running at 1,000 revolutions. After running about one hour the dynamo became slightly heated, and the experiment was discontinued for that reason, all the above tests being made with less than 30 ampères.

TABLE OF TESTS.

SERIES WOUND DYNAMO-MACHINE, HEINRICHS TYPE.

Date:—*March*, 1884.

No. of Test.	Current. E.M.F. in volts.	Current. Ampères C.	Resistances in ohms. External R − r.	Resistances in ohms. Dynamo r	Resistances in ohms. Total R	Electrical Work. Watts $C^2 R$ or $E \times C$	Electrical Work. H.P. External.	Electrical Work. H.P. Internal.	Electrical Work. H.P. Total.	Mechanical Work. Prony Brake. Weight in lbs.	Mechanical Work. Prony Brake. Length of lever. feet.	Mechanical Work. H.P. absorbed.	Revolutions of Machine.	Percentage of Efficiency. 1 Conversion.	2 Electrical.	3 Commercial.	4 Commercial.	Remarks.
														per cent.	per cent.	per cent.	per cent.	
1	...	29·0	3·23	1·68	4·91	4129	3·640	1·89	5·53	15·57	2	5·68	960	97·0	65·8	64·0	60·0	Wire resistance.
2	...	17·4	6·82	1·83	8·65	2619	2·756	·754	3·51	8·5	2	3·56	1100	98·4	78·5	77·4	68·9	Wire resistance.
3	...	17·3	9·90	1·64	11·54	3453	3·973	·657	4·63	8·843	2	4·7	1400	98·5	85·7	84·5	76·4	Wire resistance.
4	168·7	17·0	...	1·73	...	3361	3·850	·66	4·51	8·03	2	4·59	1500	98·2	85·4	83·8	75·7	1 Heinrich lamp and wire resistance.
5	202·0	23·0	...	1·84	...	5619	6·230	1·3	7·53	12·10	2	7·74	1680	97·2	82·6	80·4	75·6	6 straight carbon lamps in 2 parallels of 4 each.
6	...	21·01	9·38	1·76	11·14	4917	5·550	1·04	6·59	10·422	2	6·66	1680	98·9	84·2	83·3	77·5	Wire resistance.
7	212·0	12·63	...	1·73	...	2953	3·580	·37	3·95	5·72	2	4·03	1850	98·0	90·0	88·5	75·8	4 straight carbon lamps in series.

[The percentage of conversion will perhaps be considered very high, but it will be noticed in the method of measurement here adopted that several small sources of loss have been eliminated. We think that the means employed for these tests will commend themselves, the chances of obtaining true horse-power results being, in our opinion, exceptionally favourable.—EDS. ELEC. REV.]

* An excellent instrument by Messrs. Paterson & Cooper.—EDS. ELEC. REV.